

NUCLEAR SCIENCE ABSTRACTS

Vol. 8, No. 5, March 15, 1954

TABLE OF CONTENTS

Category	Abstract	Page	Category	Abstract	Page
CALENDAR OF MEETINGS		iv	MINERALOGY, METALLURGY, AND CERAMICS		
SELECTED SUBJECTS OF INTEREST TO INDUSTRY		v	Metals and Metallurgy	1358	
GENERAL	1276	151	PHYSICS	1379	165
BIOLOGY AND MEDICINE	1277	151	Cosmic Radiation	1387	
Aerosols	1278		Crystallography and Crystal Structure	1388	
Radiation Effects	1281		Electrons	1391	
Radiation Hazards and Protection	1295		Gases	1397	
Radiotherapy	1298		Instruments	1400	
Toxicology Studies	1299		Isotope Separation	1403	
Tracer Applications	1300		Mathematics	1404	
CHEMISTRY	1306	155	Measuring Instruments and Techniques	1406	
Analytical Procedures	1313		Mesons	1413	
Crystallography and Crystal Structure	1324		Molecular Properties	1415	
Fluorine and Fluorine Compounds	1325		Nuclear Physics	1417	
Graphite	1326		Nuclear Properties	1419	
Laboratories and Equipment	1327		Nuclear Transformation	1427	
Radiation Chemistry	1328		Radiation Absorption and Scattering	1428	
Rare Earths and Rare-earth Compounds	1331		Radiation Effects	1437	
Separation Procedures	1332		Radioactivity	1438	
Spectroscopy	1337		Rare Earths and Rare-earth Compounds	1447	
Tracer Applications	1338		Shielding	1452	
Uranium and Uranium Compounds	1339		Spectroscopy	1453	
ENGINEERING	1344	160	Theoretical Physics	1456	
Aerosols	1344		Uranium and Uranium Compounds	1469	
Heat Transfer and Fluid Flow	1345		PATENTS	1470	176
Materials Testing	1348		Chemistry	1470	
MINERALOGY, METALLURGY, AND CERAMICS	1350	161	Engineering	1474	
Geology and Mineralogy	1351		Mineralogy, Metallurgy, and Ceramics	1475	
			Physics	1476	
			AUTHOR INDEX		INDEX-1
			NUMERICAL INDEX OF REPORTS		INDEX-5

CALENDAR OF MEETINGS

Suggestions for additions to this list will be welcomed and should be sent with all pertinent information to the Cataloging Branch, Technical Information Service, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

June 20-25, 1954

NUCLEAR ENGINEERING CONFERENCE, University of Michigan, Ann Arbor, Michigan, Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineering, Ann Arbor, Michigan.

July 19-24, 1954

SECOND RADIOISOTOPE CONFERENCE (a conference on the peaceful uses of atomic energy), Oxford, England,

Arranged by: The Atomic Energy Research Establishment, Harwell.

Inquiries should be addressed to: The Conference Secretary, Atomic Energy Research Establishment, Harwell, Didcot, Berks, England.

SELECTED SUBJECTS OF INTEREST TO INDUSTRY

All AEC reports abstracted in this issue of Nuclear Science Abstracts have been reviewed and evaluated in terms of their interest and usefulness to general industry. These reports are listed below by title, author, and report number under one or more of the following nine broad categories: Chemistry and Chemical Engineering; Construction and Civil Engineering; Electronics and Electrical Engineering; Health and Safety; Industrial Management; Mechanics and Mechanical Engineering; Metallurgy and Ceramics; Mining and Geology; and Nuclear Technology. The abstract number for each report is listed at the upper right of the entry and refers to an item in the current issue of NSA.

All unclassified reports considered to be of special interest to general industry issued by the AEC prior to July, 1953 are listed or abstracted in a series of bibliographies (TID-3050), the titles of which correspond to the above-mentioned categories. As these background bibliographies become available for sale, the prices will appear in the Numerical Index of Reports which is included in each issue of this volume of NSA. These bibliographies may be purchased from the U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C.

Reproduction in whole or part of any report listed herein is encouraged by the United States Atomic Energy Commission, subject to the approval of authors or originating sites. General inquiries from the industrial press about AEC-developed information may be directed to the Industrial Information Branch, AEC, Washington 25, D. C.

CHEMISTRY AND CHEMICAL ENGINEERING

AECD-3606 1313
Oak Ridge National Lab.
MODIFICATIONS OF THE DIMETHYLGLYOXIME METHOD FOR THE COLORIMETRIC DETERMINATION OF NICKEL BASED ON THE USE OF POTASSIUM PERSULFATE AS THE OXIDANT. M. L. Druschel, O. Menis, and R. Rowan, Jr. Nov. 3, 1952. Decl. with deletions Nov. 23, 1953. 42p. Contract W-7405-eng-26. (AECD-3606; ORNL-1430)

AECD-3607 1314
Oak Ridge National Lab.
DETERMINATION OF COPPER, COBALT, AND NICKEL IN URANYL SOLUTIONS. J. M. Chilton. [Oct. 1953]. Decl. Dec. 29, 1953. 4p. Contract [W-7405-eng-26]. (AECD-3607)

AECU-2739 1332
Stanford Research Inst.
ENGINEERING AND ECONOMIC EVALUATION OF COUNTERCURRENT AND FIXED BED ION EXCHANGE PROCESSES. TECHNICAL REPORT NO. 7. Nevin K. Hiester, Raymond K. Cohen, and Russell C. Phillips. June 26, 1953. 51p. Contract AT(11-1)-110, Report No. 32. (AECU-2739)

AECU-2776 1358
Knolls Atomic Power Lab.
THE PRECISION DETERMINATION OF LOW CONCENTRATIONS OF CARBON IN METALS. Leonard P. Pepkowitz and William D. Moak. [Dec. 1953] 14p. Contract W-51-109-Eng-52. (AECU-2776)

AECU-2777 1306
Los Alamos Scientific Lab.
INFRARED ABSORPTION STUDIES OF AQUEOUS COMPLEX IONS: PART 1. CYANIDE COMPLEXES OF Ag(I) AND Au(I) IN AQUEOUS SOLUTION AND ADSORBED ON ANION RESIN. Llewellyn H. Jones and Robert A. Penneman. [1953] 20p. Contract W-7405-eng-36. (AECU-2777)

ANL-DCS-6 1315
Argonne National Lab.
RECOVERY OF HEAVY ELEMENTS FROM SEA WATER. [PART] 2. A NEW METHOD OF URANIUM ANALYSIS. D. C. Stewart and W. C. Bentley. Nov. 1953. Decl. Jan. 11, 1954. 26p. Contract W-31-109-eng-38. (ANL-DCS-6)

HW-29021 1398
Hanford Works
EXPERIMENTAL THERMAL CONDUCTIVITIES OF GASES AND GASEOUS MIXTURES AT ZERO DEGREES CENTIGRADE. J. M. Davidson and J. F. Music. July 3, 1953. 30p. Contract W-31-109-eng-52. (HW-29021)

HW-29576 1327
Hanford Works
SANDBLAST DECONTAMINATION OF STAINLESS STEEL. L. E. Kattner. Oct. 7, 1953. 17p. Contract W-31-109-Eng-52. (HW-29576)

KAPL-989 1346
Knolls Atomic Power Lab.
TEMPERATURE DISTRIBUTION IN THE WALLS OF A SLOT AS THE LEVEL OF A LIQUID IS RAPIDLY RAISED IN THE SLOT. D.P. Timo. Sept. 15, 1953. 40p. Contract W-31-109-Eng-52. (KAPL-989)

KAPL-1016 1307
Knolls Atomic Power Lab.
THE EQUILIBRIUM CONSTANT, INFRARED SPECTRUM, AND THERMODYNAMIC PROPERTIES OF BROMINE CHLORIDE. H. C. Matraw, C. F. Pachucki, and N. J. Hawkins. Dec. 1, 1953. 14p. Contract W-31-109-Eng-52. (KAPL-1016)

NYO-6154 1363
Pittsburgh Univ.
THE HEAT CAPACITY OF CADMIUM BETWEEN 12°K AND 320°K AND THE ENTROPY OF CADMIUM AT 25°C. PROGRESS REPORT FOR JULY 1, 1953–OCTOBER 1,

1953. C. A. Krier, R. S. Craig, and W. E. Wallace. Oct. 5, 1953. 10p. Contract AT(30-1)-647. (NYO-6154)
- NYO-6388 1309
Low Temperature Lab., Western Reserve Univ.
HEAT OF ADSORPTION OF ARGON ADSORBED ON
TITANIUM DIOXIDE BETWEEN 60 AND 90°K. E. L.
Pace and S. A. Greene. Issued Dec. 31, 1953. 13p.
Contract AT (30-1)-824. (NYO-6388)
- ORNL-1332 1340
Oak Ridge National Lab.
THE DENSITY OF URANYL SULFATE SOLUTIONS AND
THE DETERMINATION OF URANIUM CONCENTRATION
BY DENSITY MEASUREMENTS. J. E. Lee, Jr., R. Rowan,
Jr., C. D. Susano, and O. Menis. June 18, 1952. Decl. Jan.
11, 1954. 25p. Contract W-7405-eng-26. (ORNL-1332)
- ORNL-1578 1341
Oak Ridge National Lab.
THE CHEMISTRY OF URANIUM(VI) ORTHOPHOSPHATE
SOLUTIONS. PART 2. THE SOLUBILITY OF URANIUM(VI)
ORTHOPHOSPHATES IN PHOSPHORIC ACID SOLUTIONS.
J. M. Schreyer and C. F. Baes, Jr. June 30, 1953. Decl.
Nov. 16, 1953. 38p. Contract W-7405-eng-26. (ORNL-
1578)
- ORNL-1579 1342
Oak Ridge National Lab.
THE CHEMISTRY OF URANIUM(VI) ORTHOPHOSPHATE
SOLUTIONS. PART 3. THE SOLUBILITY BEHAVIOR OF
 $\text{UO}_2\text{HPO}_4 \cdot 4\text{H}_2\text{O}$ IN PERCHLORIC ACID SOLUTIONS. C. F.
Baes, Jr. and J. M. Schreyer. July 1, 1953. Decl. Nov.
16, 1953. 52p. Contract W-7405-eng-26. (ORNL-1579)
- ORNL-1644 1318
Oak Ridge National Lab.
DETERMINATION OF PHOSPHATE IN PERCHLORIC AND
SULFURIC ACID SOLUTIONS OF URANIUM PHOSPHATES.
ION EXCHANGE SEPARATION AND AMPEROMETRIC
DETERMINATION. E. C. Cogbill, J. C. White, and C. D.
Susano. Oct. 30, 1953. Decl. Jan. 11, 1954. 20p.
Contract W-7405-eng-26. (ORNL-1644)
- ORNL-1653 1310
Oak Ridge National Lab.
ENTHALPIES AND SPECIFIC HEATS OF ALKALI AND
ALKALINE EARTH HYDROXIDES. W. D. Powers and G. C.
Blalock. Issued Jan. 20, 1954. 48p. Contract W-7405-
eng-26. (ORNL-1653)
- UCRL-2334 1301
Radiation Lab., Univ. of Calif., Berkeley
THE DISTRIBUTION OF C^{14} IN THE CARBON ATOMS OF
PHOTOSYNTHETICALLY-PRODUCED RIBULOSE (thesis).
Anne Grace Zweifler. Sept. 1953. 48p. Contract W-7405-
eng-48. (UCRL-2334)
- UCRL-2339 1399
Radiation Lab., Univ. of Calif., Berkeley
THERMAL CONDUCTIVITY OF GASES AT HIGH TEM-
PERATURES (thesis). Albert Joel Rothman. Jan. 1954.
115p. Contract W-7405-eng-48. (UCRL-2339)
- UR-288 1319
Atomic Energy Project, Univ. of Rochester
THE SEPARATION AND IDENTIFICATION OF MIXTURES
OF C_{21} AND C_{10} STEROIDS BY PAPER CHROMATOGRAPHY.
Leonard K. Axelrod. Oct. 29, 1953. 26p. Contract W-
7401-eng-49. (UR-288)
- ELECTRONICS AND ELECTRICAL ENGINEERING**
- ANL-5181 1404
Argonne National Lab.
PROCEEDINGS OF A SYMPOSIUM ON LARGE SCALE
- DIGITAL COMPUTING MACHINERY, AUGUST 3-5, 1953.
317p. (ANL-5181)
- NAA-SR-120 1401
North American Aviation, Inc.
A REVERSING LOGARITHMIC DC AMPLIFIER. R. L.
Carter. Issued Jan. 1, 1954. 12p. Contract AT-11-1-
GEN-8. (NAA-SR-120)
- NYO-3579 1349
New York Operations Office, AEC
NON-DESTRUCTIVE TESTING BY IMPEDANCE ANALYSIS.
Richard Hochschild. June 5, 1953. 76p. (NYO-3579)
- UR-286 1344
Atomic Energy Project, Univ. of Rochester
A NEW DESIGN OF FILTER HOLDER FOR DUST
SAMPLING. K. E. Lauterbach. Oct. 15, 1953. 7p.
Contract W-7401-eng-49. (UR-286)
- HEALTH AND SAFETY**
- UR-253 1408
Atomic Energy Project, Univ. of Rochester
COMPARISON OF THE PHOTOGRAPHIC EFFECTS
PRODUCED BY CADMIUM AND RHODIUM AFTER
NEUTRON BOMBARDMENT WITH REFERENCE TO
PERSONNEL MONITORING. Gerald J. Rausa. Oct. 7,
1953. 29p. Contract W-7401-eng-49. (UR-253)
- UR-283 1285
Atomic Energy Project, Univ. of Rochester
STUDIES ON FLASH BURNS: THE INFLUENCE OF WAVE
LENGTH ON THE PRODUCTION OF CUTANEOUS BURNS.
Kelly M. Berkley and Thomas P. Davis. Sept. 30, 1953.
25p. Contract W-7401-eng-49. (UR-283)
- UR-286 1344
Atomic Energy Project, Univ. of Rochester
A NEW DESIGN OF FILTER HOLDER FOR DUST
SAMPLING. K. E. Lauterbach. Oct. 15, 1953. 7p.
Contract W-7401-eng-49. (UR-286)
- UR-287 1280
Atomic Energy Project, Univ. of Rochester
EFFICIENCY STUDIES OF THE ELECTROSTATIC
PRECIPITATOR. K. E. Lauterbach, T. T. Mercer, A. D.
Hayes, and P. E. Morrow. Oct. 15, 1953. 16p. Contract
W-7401-eng-49. (UR-287)
- MECHANICS AND MECHANICAL ENGINEERING**
- NYO-3579 1349
New York Operations Office, AEC
NON-DESTRUCTIVE TESTING BY IMPEDANCE ANALYSIS.
Richard Hochschild. June 5, 1953. 76p. (NYO-3579)
- ORNL-1598 1347
Oak Ridge National Lab.
THE EFFECT OF VISCOSITY UPON THE PRESSURE
DISTRIBUTION FOR SWIRLING FLOW THROUGH A RIGHT
CIRCULAR CYLINDER. R. H. Wilson. Issued Aug. 25,
1953. 83p. Contract W-7405-eng-26. (ORNL-1598)
- METALLURGY AND CERAMICS**
- BMI-843 1348
Battelle Memorial Inst.
THE PERFORMANCE OF WATER-LUBRICATED SLEEVE
BEARINGS. R. W. Dayton, C. M. Allen, and H. A. VanDyke.
June 19, 1953. 42p. Contract W-7405-eng-92. (BMI-843)
- ISC-350 1359
Ames Lab.
ELECTRICAL RESISTIVITY AND HALL EFFECT IN SO-

An asterisk preceding the abstract number indicates that the corresponding report is included in the "Selected Subjects of Interest to Industry" section of this issue.

GENERAL

1276

Brookhaven National Lab.

QUARTERLY PROGRESS REPORT [FOR] JULY 1-SEPTEMBER 30, 1953. (UNCLASSIFIED SECTION). 57p. (BNL-259)

Abstracts of papers from the Physics, Chemistry, and Biology Depts. which are being reported concurrently in the scientific journals are presented. The Instrumentation and Health Physics Dept. studies reported include improved pulse-height analyzer and coincidence circuitry for the gray-wedge spectrometer, an improved rate meter with overlapping scales in the range 10 to 10,000 cps, increased sensitivity of the Ca oxalate method of urinalysis for fission products, cosmotron environs monitoring, and a summary of waste disposal data for the period. Studies which are being pursued to improve cosmotron operation are summarized. Curves showing the total scattering cross sections for π^+ and π^- mesons by protons as a function of meson energy are presented. Neutron resonances were assigned to Eu^{151} after neutron activation of Eu samples. Antiferromagnetism of CuO at 220°K was further established. Radiation polymerization of styrene, acrylamide, and *n*-vinyl pyrrolidone is discussed briefly. Radiobiological studies reported include induced resistance to stem rust in oats by thermal neutron irradiation of seed, effects of γ radiation on keeping qualities of potatoes, and tumor induction in radiothyroidectomized mice by x irradiation of the whole body or of the head. (For preceding period see BNL-243.) (L.M.T.)

BIOLOGY AND MEDICINE

1277

Los Alamos Scientific Lab.

VISCOSITY STUDIES ON THE SODIUM DESOXYRIBONUCLEATES OBTAINED FROM PNEUMOCOCCUS TYPE III AND PNEUMOCOCCUS TYPE VI. Virgil L. Koenig. [1953]. 7p. Contract W-7405-eng-36. (AECU-2782)

Intrinsic viscosities have been determined for Na desoxyribonucleate from pneumococcus type III and pneumococcus type VI, using the Ostwald capillary viscometer. (C.H.)

AEROSOLS

1278

National Gas Turbine Establishment (Great Britain)
SOME TESTS ON A HIGH EFFICIENCY AIR CLEANER.
D. R. Whittet. July 1953. 40p. (NGTE-R-139)

Performance tests were conducted on a special form of Cottrell precipitator in which a moving film of water forms

the receiving electrode. The tests were conducted mainly on three different lengths of 3-in. tube with length-to-diameter ratios ranging from 13.1 to 33.5 and at air velocities ranging from 3 ft/sec to 10 ft/sec. Blackness test efficiencies as high as 99.99% were recorded in the laboratory when using air polluted with C smoke as a test atmosphere, and up to 99.94% when cleaning a typical industrial atmosphere. The performance of the cleaner at differing conditions of air velocity, applied voltage, wire diameter, tube diameter, and tube length is examined, and a comparison is made between the actual test results and those forecast by application of certain commonly used expressions for efficiency and field strength. An examination is also made of the power requirements of this type of cleaner, and recommendations are made concerning the most economical form of construction and the choice of tube dimensions. (auth)

1279

Little, Arthur D., Inc.

PROPERTIES OF VARIOUS FILTERING MEDIA FOR ATMOSPHERIC DUST SAMPLING. Walter J. Smith and Norman F. Surprenant. July 1, 1953. 25p. (NP-5007)

A group of atmospheric dust sample media has been studied for performance characteristics. The media were selected to represent those in use in a number of laboratories. Test methods used were di-octyl phthalate (DOP) smoke penetration, atmospheric dust penetration, efficiency by particle size, and plugging rate on atmospheric dust. A wide range of properties were shown. The filtering properties have been discussed, and the suitability of the media for various applications has been indicated. It has been demonstrated that efficiency measurements by the DOP smoke test follow very closely the results given by atmospheric dust counts. This suggests that the fast DOP method can be used to rate any filter medium on per cent of atmospheric dust penetration by particle count. (auth)

*1280

Atomic Energy Project, Univ. of Rochester

EFFICIENCY STUDIES OF THE ELECTROSTATIC PRECIPITATOR. K. E. Lauterbach, T. T. Mercer, A. D. Hayes, and P. E. Morrow. Oct. 15, 1953. 16p. Contract W-7401-eng-49. (UR-287)

Tests of the electrostatic precipitator in collecting a radioactive aerosol have shown that the instrument retains a uniformly high percentage of airborne particulate material. The percentage of dust penetration through the precipitator was calculated from the original aerosol activity and the activity of the deposit collected on three molecular filters in series following the test instrument. The method of testing has been found to give reproducible results in estimating penetration values as low as 0.005%. On the basis of a number of tests of molecular filters in series, the efficiency of this filtering medium appears to be extremely high. (auth)

RADIATION EFFECTS

1281

Stanford Univ.

EFFECT OF NUTRITIONAL STATE ON PHOTOREACTIVATION IN DIDINIUM NASUTUM. A. C. Giese, C. L. Brandt, and D. C. Shepard. [1953] 19p. Contract AT (11-1)-234. (AECU-2781)

The effect of nutritional state in protozoa on sensitivity to ultraviolet radiation, as measured by viability and division rate, was studied in *Didinium nasutum*. Experimental results and theoretical implications of the results are discussed. (C.H.)

1282

Air Force Radiation Lab., Univ. of Chicago

QUARTERLY PROGRESS REPORT NO. 9. Oct. 15, 1953. 131p. Contract AF-33(038)-27355. (NP-4961)

Separate abstracts have been prepared on two sections of this report. (For preceding period see NP-4846.) (C.H.)

1283

Air Force Radiation Lab., Univ. of Chicago

[PHYSIOLOGICAL EFFECTS OF RADIATION]. p.1-70 of QUARTERLY PROGRESS REPORT NO. 9. Oct. 15, 1953. 70p. Contract AF-33(038)-27353. (NP-4961(p.1-70))

Progress is reported in studies of the protective effects of cysteine and of *p*-aminopropiophenone, administered singly and together, on the radioinduced increase in adenosine triphosphatase activity of the spleen and thymus of rats. The effects of doses of 10,000 r and 30,000 r x radiation on increasing the 5-nucleotidase activity of mouse tissues were determined. The chronic use of caffeine, dexedrine, and benzedrine did not alter the survival time or weight loss in x-irradiated rats when given before the irradiation and had only slight effect when given following exposure to x radiation. The ability of rat kidney, liver, heart, and brain slices to oxidize glucose, pyruvate, and succinate was not affected at 4, 24, and 48 hr after doses of 10,000 r and 20,000 r x radiation. When results of studies of the effects of radiation on the cholinesterase activity of mouse tissues were compared with results from previous studies on rats, a species difference was indicated in the amounts of pseudo-cholinesterase activity in the tissues. (C.H.)

1284

Air Force Radiation Lab., Univ. of Chicago

[RADIATION EFFECTS]. p.71-129 of QUARTERLY PROGRESS REPORT NO. 9. Oct. 15, 1953. 59p. Contract AF-33-(038)-27353. (NP-4961(p.71-129))

Studies were continued on the effects of anesthetic agents on the mortality of x irradiated rats, and data are presented on the effects of thiopental sodium and cyclopropane, administered at various times post-irradiation, and of urethane on radiation mortality of rats. Results of studies indicate *p*-aminopropiophenone offers no protection against injuries to mice due to chronic radiation exposure. Preliminary results of studies to determine the manner in which *p*-aminopropiophenone exerts its protective effect against acute radiation injury in mice are given. No significant differences were observed in the catalase activity in tissues of hibernating as compared with non-hibernating gophers. No protective effect was afforded by catalase against radiation injury to amoeba. A comparison is reported of the effects of ionizing radiation and sulfur mustard on the viscosity of solutions of Na alginate. Mixtures of O₂, H₂, He, and N₂ offered no protective effects to mice when administered before and during x irradiation. Data are presented graphically on the effects of x irradiation, applied in single and repeated doses, on the amounts of acetone and ammonia in the expired air of rabbits measured at various times after exposure to radiation. A

revision of Cohn's procedure for the determination of minute quantities of adenosine nucleotides in animal tissues, following separation by anion-exchange chromatography, is described. Data are included on the adenylic acid levels in the spleens of rats following whole-body x irradiation. No effects on the 30-day mortality of mice were produced by any of 25 chemical compounds screened. Data on dosages are presented in tabular form. (C.H.)

*1285

Atomic Energy Project, Univ. of Rochester

STUDIES ON FLASH BURNS: THE INFLUENCE OF WAVE LENGTH ON THE PRODUCTION OF CUTANEOUS BURNS. Kelly M. Berkley and Thomas P. Davis. Sept. 30, 1953. 25p. Contract W-7401-eng-49. (UR-283)

The influence of the three general regions of the spectrum, ultraviolet, visible, and infrared, on the production of cutaneous burns in swine at 0.5- and 1.0-sec exposure times was studied. The energy required to cause equivalent burns was compared region by region, and to that of the C arc source alone. Data were analyzed by a simplified method of probit analysis. It was found, in general, that the 50% effective dose of infrared radiation is significantly greater than that of the unmodified radiation of the C arc source. This difference is most marked at the erythema level. The type of erythema varied according to the presence or absence of ultraviolet radiation. (auth)

1286

THE INITIATION AND DEVELOPMENT OF CELLULAR DAMAGE BY IONIZING RADIATIONS. L. H. Gray. (Hammersmith Hospital, London). *Brit. J. Radiol.* 26, 609-18(1953). Dec.

Modern concepts of the initiation and development of damage to plant and animal cells by ionizing radiations are reviewed. The influence of primary localization of ionizing energy along discrete tracts of individual particles and the influence of radioinduced chemical changes on biological damage are discussed. The effects of the radioinduced decomposition of water, H₂O₂ formation, O tension, enzyme inactivation, and the formation of reducing radicals on radiosensitivity are examined. (C.H.)

1287

EFFECT OF WHOLE BODY X-IRRADIATION ON ASCORBIC ACID OF RAT TISSUES. H. L. Oster, A. L. Kretchmar, and F. H. Bethell (Univ. of Michigan, Ann Arbor). *Proc. Soc. Exptl. Biol. Med.* 84, 470-3(1953). Nov.

Evidence obtained from an experiment with rats of the Long-Evans strain suggests that mid-lethal whole-body x irradiation may directly reduce tissue ascorbic acid. In rats of the Wistar strain, however, except for the adrenal glands, a higher dose did not result in an immediate reduction in tissue ascorbic acid but rather a tendency to increase was noted. In both strains, the effect of x irradiation on the adrenal ascorbic acid could be ascribed to activation of the pituitary. In the Wistar strain animals, the changes in the ascorbic acid of the liver and blood could also be explained by this mechanism. (auth)

1288

REPRODUCIBILITY OF X-RAY SURVIVAL CURVES FOR YEAST CELLS. Thomas H. Wood (Univ. of Pennsylvania, Philadelphia). *Proc. Soc. Exptl. Biol. Med.* 84, 446-52 (1953). Nov.

Accurate and reproducible x-ray survival curves were obtained for both haploid and diploid yeast under carefully controlled conditions. The haploid curve is exponential down to survivals of 10⁻⁴ or lower for old cultures; the diploid curve is sigmoid, and a good fit can be obtained by use of the proper multitarget model. The slope of the haploid survival curve depends on the culture age, young cultures being more sensitive. The haploid curves exhibit

tails at low survival levels; the position of the tail is also dependent on the culture age, young cultures showing the tail at higher survival levels. The goodness of fit of the experimental points of the haploid yeast survival curves to an exponential curve is evidence that the rate-limiting inactivation step is first order as postulated in the diffusion model of Zirkle and Tobias. (auth)

1289

INFLUENCE OF HIBERNATION ON SURVIVAL TIME AND WEIGHT LOSS OF X-IRRADIATED GROUND SQUIRRELS. John Doull and Kenneth P. DuBois (U. S. Air Force Radiation Lab. and Univ. of Chicago). *Proc. Soc. Exptl. Biol. Med.* **84**, 367-70(1953). Nov.

The LD₅₀ of x ray for nonhibernating ground squirrels (*Citellus tridecemlineatus*) is approximately 700 r. Nonhibernating animals given 800 r of x ray exhibited over 80% mortality within 10 days. Ground squirrels irradiated while in hibernation and maintained in the hibernating state following irradiation exhibited no mortality within 30 days following exposure to x ray, but when these animals were returned to the homeothermic state either at 2 weeks or at 4 weeks after irradiation, death ensued within 10 days. Animals which were maintained in hibernation following lethal doses of x ray eventually succumbed, although survival was greatly prolonged. Thus, while hibernation markedly increased the survival time in this species following lethal doses of x ray, it did not alter the ultimate mortality. (auth)

1290

ROENTGEN PARALYSIS IN THE MOUSE. V. V. Brunst (Roswell Park Memorial Inst., Buffalo, New York). *Am. J. Roentol. Radium Therapy Nuclear Med.* **71**, 131-8(1954). Jan.

The bodies of 268 mice at the age of 1, 2, 3, 4, 5, 6, 10, 15, 20, and 25 days were irradiated with 3,400 to 5,000 r midway between the fore and hind limbs through a localizer slit 4 mm in width. A paralysis is never observed following x irradiation of mice at the ages of 5 to 25 days. But after irradiation of mice 1 to 4 days old, paralysis was seen in some cases. This paralysis was observed usually in animals which were irradiated exactly in the region of the motor neurons controlling the hind limbs. Histopathological examination showed that in most cases the appearance of the spinal cord of the paralyzed mice is normal. Obviously, the damage occurs only in some cells of the spinal cord and is very difficult to detect by the usual histopathological examination. However, in some cases, the damage of the spinal cord is evident. In these animals, irradiation was made in the chest region, and complete interruption of the spinal cord probably is the result of weakness of the affected portion of the vertebral column. This interruption provokes the secondary alteration of the function of motor neurons in the lumbar region and, as a result of this, complete paralysis occurs. The change in x-ray sensitivity of the spinal cord occurs approximately between 4 and 5 days after birth. At this time, the neurons controlling the hind limb transformed from cells relatively sensitive to roentgen rays to the more resistant status of the adult form. (auth)

1291

INFLUENCE OF WHOLE BODY X-IRRADIATION, COLD EXPOSURE AND EXPERIMENTAL ACIDOSIS ON PROTEIN COMPOSITION AND AZORUBIN-BINDING CAPACITY OF RAT SERUM. Ulrich Westphal, Stanley G. Priest, John F. Stets, and George L. Selden. (Army Medical Research Lab., Fort Knox, Ky.). *Am. J. Physiol.* **175**, 424-8(1953). Dec.

Total protein and albumin were significantly reduced in the serum of rats 2 and 3 days after exposure to x rays.

Alpha and β globulin were increased whereas γ globulin was decreased in the irradiated animals. No influence on the azorubin-binding capacity (ABC) was observed. Exposing rats to +4°C for 18 days, or subjecting them to a severe state of acidosis, did not affect the ABC values of the serum albumin. (auth)

1292

THE CONCENTRATION OF OXYGEN DISSOLVED IN TISSUES AT THE TIME OF IRRADIATION AS A FACTOR IN RADIOTHERAPY. L. H. Gray, A. D. Conger, M. Ebert, S. Hornsey, and O. C. A. Scott (Hammersmith Hospital, London). *Brit. J. Radiol.* **26**, 638-48(1953). Dec.

The sensitivity of tumor cells to x rays has been shown to be about three times as great when irradiated in a well-oxygenated medium as under anoxic conditions. The manner in which sensitivity depends on O tension closely resembles that found by other workers for plant and insect tissues. The sensitivity of the tumor cells to fast neutron radiation is only slightly affected by O tension. Consideration is given to the supply of O to tissues as a factor in radiotherapy, and it is concluded on the basis of existing knowledge that in certain circumstances the effectiveness of x-ray treatment might be increased if the patient were breathing O at the time of irradiation. Results of studies of varied O tension on radiation effects on cells in tissue cultures are described. (auth)

1293

BRAIN AND LIVER PHOSPHORUS METABOLISM IN THE ACUTE IRRADIATION SYNDROME. Warner H. Florsheim and M. E. Morton. (Veterans Administration Hospital, Long Beach, and Univ. of Calif., Los Angeles). *Am. J. Physiol.* **176**, 15-19(1954) Jan.

The incorporation of peripherally administered tracer phosphate into the brain tissue was not changed by irradiation with 20,000 r of x rays. This would indicate that any possible alteration in capillary permeability or vascular supply produced by irradiation does not affect the brain's supply of phosphate nor its ability to incorporate this into organic compounds. In addition, the P metabolism of liver after irradiation was not demonstrably altered from the control. The phosphorylative efficiency of liver slices irradiated in vitro likewise remained unchanged. Clinical and histological effects of irradiation also could not be attributed to changes in the levels of either blood glucose or brain cholinesterase. (auth)

1294

EFFECTS OF PLOIDY AND LINEAR TRANSFER ON RADIOBIOLOGICAL SURVIVAL CURVES. Raymond E. Zirkle (Univ. of Chicago) and Cornelius A. Tobias (Univ. of Calif., Berkeley). *Arch. Biochem. and Biophys.* **47**, 282-306(1953). Dec.

The radiobiological influence of linear energy transfer was investigated with respect to inhibition of cell division in a diploid strain of yeast, a haploid strain of yeast derived from the diploid, and a unicellular green algae. Data are tabulated on the effects of ploidy and linear energy transfer on the radiobiological survival curves. (C.H.)

RADIATION HAZARDS AND PROTECTION

1295

A STUDY ON THE PROTECTIVE ACTION OF 2,3-DIMERCAPTOPROPANOL (BAL) ON RADIATION-INDUCED CHANGES IN THE OVARIAN FOLLICLES IN MICE. Erik Odeblad (Karolinska Institutet, Stockholm, Sweden). *Acta Radiol.* **40**, 493-9(1953). Nov.

Mice were given internal irradiation with P³² (5 μ c/g) and external total-body irradiation with x rays (400 to 600 r). Some of the animals were treated with 2,3-dimercaptopropanol (BAL). The animals were sacrificed after 4 or 6

days. Follicular diameters in the ovaries were measured and grain countings were undertaken on ovarian autoradiographs. Significant protection was obtained against irradiation effects with the BAL in the P^{32} -treated animals. No significant protection was obtained in the roentgen irradiated mice. This may be due to the fact that repeated injections of BAL were given in the P^{32} -irradiated mice, but only one injection of BAL in the roentgen irradiated mice. Treatment of radioisotope intoxication by means of sulfhydryls is suggested. (auth)

1296

CITROVORUM AND IRRADIATION INJURY. Dorothy J. Buchanan, William N. Pearson, Chandra Amarasingham, Granville W. Hudson, and William J. Darby (Vanderbilt Univ., Nashville, Tenn.). *Am. J. Physiol.* **175**, 437-9(1953). Dec.

Citrovorum factor in the amount of 1 mg/day injected intraperitoneally prior to and following whole-body x irradiation failed to alter the clinical course or the leucopenia and subsequent leucopoiesis in female albino rats. (auth)

1297

TIME AS A FACTOR IN POSTIRRADIATION PROTECTION BY PARABIOSIS. R. T. Binhammer, M. Schneider, and J. C. Finerty. (Univ. of Texas Medical Branch, Galveston). *Am. J. Physiol.* **175**, 440-2(1953). Dec.

The effect of delayed union after exposure to x radiation upon the effectiveness of protection by postirradiation parabiosis was investigated. A significant number of irradiated animals without postirradiation treatment for as long a period as 4 days escaped seemingly inevitable radiation death when they were paired with nonirradiated partners. Similarly, the effect of shortening the duration of parabiosis was determined in a large number of pairs. Mortality increased in a linear fashion as the time in parabiosis was reduced but some rats were permanently protected after parabolic union of only 4 days. It is concluded that the critical period for postirradiation protection by parabiosis lies between the 6th and 10th postirradiation day. (auth)

RADIOTHERAPY

1298

INTRACAVITARY USE OF COLLOIDAL RADIOACTIVE GOLD. Gould A. Andrews, Samuel W. Root, Ralph M. Kniseley, and Herbert D. Kerman (Oak Ridge Inst. of Nuclear Studies, Tenn.). *Radiology* **61**, 922-9(1953). Dec.

Results are summarized in 39 cases in which colloidal Au^{198} was injected into the pleural or peritoneal spaces of patients with effusions caused by neoplasms. (C.H.)

TOXICOLOGY STUDIES

1299

TRANSPORT OF RADIUM SULFATE FROM THE LUNG AND ITS ELIMINATION FROM THE HUMAN BODY FOLLOWING SINGLE ACCIDENTAL EXPOSURES. L. D. Marinelli, W. P. Norris, P. F. Gustafson, and T. W. Speckman. (Argonne National Lab., Lemont, Ill.) *Radiology* **61**, 903-15(1953). Dec.

Six persons who suffered single accidental exposures to $RaSO_4$ dust were examined during the following year for exhalation of Rn and for γ -ray activity from the thorax and from the body as a whole. Measurements of Ra in the excreta of one individual were obtained for 250 days. The pattern of these measurements was found to differ markedly from observations made on human cases of chronic Ra poisoning. Observations made on these persons led to the conclusion that estimates of Ra body burden based solely either on Rn or excretion measurements are likely to be seriously in error if applied to cases of recent exposure to insoluble dusts. (C.H.)

TRACER APPLICATIONS

1300

Hanford Works

THE ABSORPTION OF INORGANIC IONS BY CHLORELLA PYRENOIDOSA. H. J. Knauss and J. W. Porter. Nov. 16, 1953. 18p. Contract W-31-109-Eng-52. (HW-29993)

The isotope method was used to determine the quantities of an element present in Chlorella when the nutrient concentration of that element was varied. Elements used in these studies were P, Ca, S, Fe, Mn, Zn, Cu, and Sr. The absorption by the algae of all elements, except P and S, was directly proportional to the concentration of that element in the nutrient solution. The quantities of P and S in the algal cells were constant when the cells were grown in the higher nutrient concentrations of these elements. A brief discussion is presented of the sources of error existent in the isotope method of determining actual content of an element in algae. The importance of studies on the effect of nutrient concentration of an element on its absorption by algae to research on the effect of transmutation in algae is also mentioned. (auth)

*1301

Radiation Lab., Univ. of Calif., Berkeley

THE DISTRIBUTION OF C^{14} IN THE CARBON ATOMS OF PHOTOSYNTHETICALLY-PRODUCED RIBULOSE (thesis). Anne Grace Zweifler. Sept. 1953. 48p. Contract W-7405-eng-48. (UCRL-2334)

Methods have been developed for a complete degradation of ribulose. These methods have been applied to labeled ribulose, formed during a variety of photosynthetic experiments with $C^{14}O_2$. The experiments included both the batch and flow type experiments, experiments performed with different organisms, and experiments of different duration. The results of the ribulose degradations, in conjunction with sedoheptulose degradations from the same and different photosynthetic experiments, indicate that modifications of the previously proposed photosynthetic cycle may be in order. Data indicate that no free diose or tetrose is involved; sedoheptulose is formed from hexose, eliminating the second carboxylation; ribulose is formed both from sedoheptulose and from C_2 plus C_2 combination; and ribulose is the CO_2 acceptor. (auth)

1302

Atomic Energy Project, Univ. of Rochester

THE METABOLISM OF L-LYSINE-6- C^{14} . Morton Rothstein and Leon L. Miller. Oct. 29, 1953. 26p. Contract W-7401-eng-49. (UR-289)

An isotope-trapping technique has been used in rats which permits the identification of specific catabolites from radioactive precursors. By this technique evidence for the following in vivo conversions has been obtained in the rat: lysine to glutaric acid, α -aminoadipic acid to glutaric acid, glutaric acid to α -ketoglutaric acid plus acetate, and lysine to α -ketoglutaric acid plus acetate. In addition, a lesser conversion of lysine-6- C^{14} to formate takes place. Interpretation of these and other experimental results supports the conclusion that lysine is metabolized in vivo as follows: lysine \rightarrow α -aminoadipate \rightarrow glutarate \rightarrow α -ketoglutarate + acetate. The latter compounds yield 3,4-labeled glucose. Formate- C^{14} derived from lysine-6- C^{14} is probably responsible for the small amount of isotope found in carbons 1,2,5, and 6 of glucose derived from lysine-6- C^{14} in phlorizinized rats. (auth)

1303

THE HEPATIC RADIOACTIVITY SURVEY. Lloyd A.

Stirrett, Eric T. Yuhl, and Raymond L. Libby (Wadsworth Hospital and Univ. of Calif., Los Angeles). *Radiology* **61**, 930-4(1953). Dec.

The technique of hepatic radioactivity survey for the

diagnosis of metastatic cancer of the liver following administration of I^{131} -labeled human serum albumin has been described. A series of 210 patients have been studied and an over-all diagnostic accuracy of 96% has been obtained. (auth)

1304

THE DIAGNOSIS OF MORPHOLOGIC ABNORMALITIES OF THE HUMAN THYROID GLAND BY MEANS OF I^{131} . Franz K. Bauer, William E. Goodwin, Raymond L. Libby, and Benedict Cassen (Wadsworth Hospital and Univ. of Calif., Los Angeles). *Radiology* 61, 935-7(1953). Dec.

A method using radioactive iodine for the visualization of the frontal profile of the thyroid gland is described. The indications for the procedure are discussed, and illustrative cases are presented. (auth)

1305

DETECTION OF INTRAOCULAR TUMORS WITH THE USE OF RADIOACTIVE PHOSPHORUS. Jack S. Krohmer, Charles I. Thomas, John P. Storaasli, and Hymer L. Friedell (Western Reserve Univ., Cleveland, Ohio). *Radiology* 61, 916-21(1953). Dec.

Thirty-two cases of various intraocular lesions have been studied. Measurement of the differential uptake of P^{32} in tumors appears to afford a clear separation of neoplastic from non-neoplastic disease. This is most effective in the anterior segment. To establish the diagnosis in neoplasms located in the posterior portion of the globe, a counter which will permit closer apposition to the tumor will be necessary. The results of the P^{32} -uptake studies must be considered as an adjunct to careful clinical evaluation of suspected eye tumors rather than a conclusive diagnostic test. (auth)

CHEMISTRY

*1306

Los Alamos Scientific Lab.
INFRARED ABSORPTION STUDIES OF AQUEOUS COMPLEX IONS: PART 1. CYANIDE COMPLEXES OF $Ag(I)$ AND $Au(I)$ IN AQUEOUS SOLUTION AND ADSORBED ON ANION RESIN. Llewellyn H. Jones and Robert A. Penneman. [1953] 20p. Contract W-7405-eng-36. (AECU-2777)

Techniques are described for obtaining infrared absorption spectra of complex cyanide anions in aqueous solution and adsorbed on anion resin. In the system $AuCN-KCN-H_2O$, only the soluble complex ion $Au(CN)_2^-$ is observed; the molar extinction coefficient (ϵ) is $477 \pm 25 \text{ mol}^{-1} \text{ liter cm}^{-1}$ at $2147 \pm 1 \text{ cm}^{-1}$. When $Au(CN)_2^-$ is adsorbed to the extent of 47 wt. % on Dowex-A-1 resin, its absorption maximum appears at 2138 cm^{-1} . Three distinct Ag cyanide complex ions were observed in aqueous solution: $Ag(CN)_2^-$, $\epsilon = 264 \pm 12$ at $2135 \pm 1 \text{ cm}^{-1}$; $Ag(CN)_3^{2-}$, $\epsilon = 397 \pm 23$ at $2105 \pm 1 \text{ cm}^{-1}$; $Ag(CN)_4^{3-}$, $\epsilon = 556 \pm 83$ at $2092 \pm 1 \text{ cm}^{-1}$. Approximate values (calculated in terms of activities) of the dissociation constants for the tri- and tetra-cyanide complexes into the next lower complex are $K_{4,3} = 0.20 \pm 0.05 \text{ mol/liter}$, and $K_{4,2} = 13.4 \pm 4 \text{ mol/liter}$, respectively. (auth)

*1307

Knolls Atomic Power Lab.
THE EQUILIBRIUM CONSTANT, INFRARED SPECTRUM, AND THERMODYNAMIC PROPERTIES OF BROMINE CHLORIDE. H. C. Matraw, C. F. Pachucki, and N. J. Hawkins. Dec. 1, 1953. 14p. Contract W-31-109-Eng-52. (KAPL-1016)

The equilibrium constant of 0.15 for the gaseous system $2BrCl = Br_2 + Cl_2$ was determined by means of a mass spectrometer. The fundamental vibration frequency of $BrCl$ was observed at 439.5 cm^{-1} wave numbers in the infrared spectrum. The thermodynamic properties $-(F - E_0^0)$, S , and C_p were calculated for one mole of gas at atmospheric pressure from 100 to $1000^\circ K$. From the thermodynamic properties, equilibrium constant, and known standard-state properties of Br_2 and Cl_2 , the standard-state properties of $BrCl$ were computed. There was no evidence for the existence of $BrCl_3$. (auth)

1308

Technical Information Div., Library of Congress
REPORTS ON BORON COMPOUNDS. (ABSTRACT BULLETIN U1). Dec. 21, 1953. 10p. (NP-5020)

*1309

Low Temperature Lab., Western Reserve Univ.
HEAT OF ADSORPTION OF ARGON ADSORBED ON TITANIUM DIOXIDE BETWEEN 60 AND $90^\circ K$. E. L. Pace and S. A. Greene. Issued Dec. 31, 1953. 13p. Contract AT (30-1)-824. (NYO-6388)

The heat of adsorption of A on TiO_2 has been measured with a modified Nernst-Giauque calorimeter at temperatures of 63.5 , 73.0 , 78.5 , and $86.5^\circ K$ for concentrations ranging to a maximum value of the order of a monolayer. The heat capacity of the adsorbed phase was determined between 55 and $90^\circ K$ in the same range of concentrations. By using the heat capacity data, it was found possible to reduce the experimentally determined differential heats of adsorption at 73.0 , 78.5 , and $86.5^\circ K$ to a single curve at $63.5^\circ K$ within the experimental error. Therefore, at these temperatures, it is believed that the experimental method has yielded thermodynamically reversible results. The results of the experimental measurements at $63.5^\circ K$ do not fall on the single curve, and consequently the adsorption process appears to be metastable at this temperature. The differential heat curves for the equilibrium and non-equilibrium processes have been used to determine the corresponding energy distribution at the sites of adsorption. (auth)

*1310

Oak Ridge National Lab.
ENTHALPIES AND SPECIFIC HEATS OF ALKALI AND ALKALINE EARTH HYDROXIDES. W. D. Powers and G. C. Blalock. Issued Jan. 20, 1954. 48p. Contract W-7405-eng-26. (ORNL-1653)

The enthalpies and heat capacities of Li , K , Sr , and Ba hydroxides in the liquid and solid state have been determined with a Bunsen ice calorimeter; $NaOH$ and the Li - $NaOH$ eutectic in the liquid state were also studied. Estimates of the heat of fusion have been made. General empirical equations have been developed which represent the enthalpy and heat capacity of the hydroxides in the liquid state. (auth)

1311

Geological Survey
STABILITY OF METALLIC IONS IN DILUTE SOLUTION. Robert G. Milkey. Nov. 1953. 23p. (TEI-373)

Standard solutions and samples containing a few μg of metallic ion per ml are frequently used in trace-elements analysis. It is important to know whether the concentrations of such solutions remain constant from day to day. The stability of dilute solutions of three metallic ions— U , Pb , and Th —has been investigated. The approximate pH of solutions that lost strength after standing for 2.5 months was determined, with the concentration of metallic ion varying from 1000 to $0.1 \mu g/ml$. Both adsorption and hydrolysis variously influenced the solute loss, but the minimum pH at which loss of concentration of Pb and U occurred seemed to coincide with the pH at which the

product of the hydrolysis of the metallic ion begins to precipitate. The effect on stability of substituting polyethylene containers was investigated. No increase in stability was thereby obtained. It was further determined that the solutions which lost strength could not be restored promptly to the original concentration by some manual means such as shaking vigorously for several minutes. (auth)

*1312

POLYPHOSPHATES AS POLYELECTROLYTES. II. VISCOSITY OF AQUEOUS SOLUTIONS OF GRAHAM'S SALTS. Ulrich P. Strauss and Edward H. Smith (Rutgers Univ., New Brunswick, N. J.) *J. Am. Chem. Soc.* **75**, 6186-8(1953) Dec. 20. (cf. NSA 7-4046).

The viscosity behavior of aqueous solutions of several samples of Na polyphosphate, covering a molecular weight range from 7000 to 19,000, was investigated. The results for each sample could be represented by the Fuoss equation, $\eta_{sp}/C = A/(1 + B\sqrt{C}) + D$. The parameters A, B and D all increased with molecular weight. The intrinsic viscosity, $A + D$, was proportional to the 1.87th power of the molecular weight, indicating rod-like structure of the polyions at infinite dilution. The end-to-end distances of the polyions at infinite dilution, estimated from the intrinsic viscosity values, were of the same order of magnitude as their contour lengths, calculated from the molecular weights, confirming the absence of chain branching of these polyelectrolytes in solution. (auth)

ANALYTICAL PROCEDURES

*1313

Oak Ridge National Lab.
MODIFICATIONS OF THE DIMETHYLGLYOXIME METHOD FOR THE COLORIMETRIC DETERMINATION OF NICKEL BASED ON THE USE OF POTASSIUM PERSULFATE AS THE OXIDANT. M. L. Druschel, O. Menis, and R. Rowan, Jr. Nov. 3, 1952. Decl. with deletions Nov. 23, 1953. 42p. Contract W-7405-eng-26. (AECD-3606; ORNL-1430)

Potassium persulfate was used as the oxidizing reagent in the dimethylglyoxime method for the colorimetric determination of Ni. The optimum conditions, including pH, wavelength, temperature, quantity of reagents, tolerance for interfering ions, and time factors were determined. The preferred procedures for two ranges of Ni concentration, 0.2 to 1.5 and 1.5 to 8.0 $\mu\text{g}/\text{ml}$, as well as a modified procedure suitable for the entire range, are given. The standard deviation of the method, under the best conditions, is less than 2%. (auth)

*1314

Oak Ridge National Lab.
DETERMINATION OF COPPER, COBALT, AND NICKEL IN URANYL SOLUTIONS. J. M. Chilton. [Oct. 1953]. Decl. Dec. 29, 1953. 4p. Contract [W-7405-eng-26] (AECD-3607)

Several modifications of the method of Chilton (*Anal. Chem.* **25**, 1274(1953)) for the colorimetric determination of Cu, Co, and Ni have been developed to make it especially applicable to concentrated solutions of uranyl ions. The modified method has approximately twice the sensitivity of the original, with only a slight decrease in precision. (auth)

*1315

Argonne National Lab.
RECOVERY OF HEAVY ELEMENTS FROM SEA WATER. [PART] 2. A NEW METHOD OF URANIUM ANALYSIS. D. C. Stewart and W. C. Bentley. Nov. 1953. Decl. Jan. 11, 1954. 26p. Contract W-31-109-eng-38. (ANL-DCS-6)

A new method for the analysis of U in sea water is described. The procedure utilizes a solvent mixture (dibutyl ortho phosphoric acid in CCl_4) to concentrate the U,

following which the amount present is estimated by fission-fragment counting in a neutron reactor. With no special precautions being taken, ocean water samples of 20 to 50 ml size can be assayed with a precision of $\pm 5\%$. The method should make it possible to determine the U in a semiquantitative way in as little as 0.1 ml of sample by a moderate amount of effort in reducing counting backgrounds or by using coincidence counting techniques. By using this method on a very limited number of samples, a value of 2.49 μg of U/l was found for Pacific Ocean water collected near the shore. A similar preliminary value of 5.1 μg U/l was found for a single sample taken from Great Salt Lake, Utah. (auth)

1316

Hanford Works
THE LESS FAMILIAR ELEMENTS IN THE ATOMIC ENERGY PROGRAM. A. H. Bushey. Oct. 12, 1953. Decl. Dec. 14, 1953. 31p. Contract W-31-109-eng-52. (HW-29599)

The advances in analytical chemistry over the past 10 or 12 years are briefly reviewed, especially emphasizing the impetus given the field by the atomic energy program. Specific examples of recent developments from analytical research effort at Hanford which are discussed include coulometric titration equipment and techniques, γ -ray scintillation spectrometry, continuous analytical α - and γ -monitoring devices, and x-ray photometry. (L.M.T.)

1317

National Bureau of Standards
DETERMINATION OF CARBON 14 IN SOLUTIONS OF LABELED MATERIALS BY MEANS OF A PROPORTIONAL COUNTER. A. Schwebel, H. S. Isbell, and J. D. Moyer. Nov. 15, 1953. 14p. (NBS-2837)

A simple, rapid, and precise method is presented for the assay of C^{14} -labeled substances. The material to be assayed is dissolved in a suitable solvent, and the radiation from the solution is measured with a commercial gas-flow proportional counter. The characteristics of suitable solvents are discussed, and it is shown that formamide and ethylene glycol are particularly useful. The counting efficiency was found to be inversely proportional to the density of the solution counted. Ordinarily the efficiency of a given cell and counter does not change from day to day, but major adjustments of the counter may cause considerable change. Hence, it is necessary to check the counting efficiency from time to time by measurement of a material of known activity. (cf. NSA 5-4823.) (auth)

*1318

Oak Ridge National Lab.
DETERMINATION OF PHOSPHATE IN PERCHLORIC AND SULFURIC ACID SOLUTIONS OF URANIUM PHOSPHATES. ION EXCHANGE SEPARATION AND AMPEROMETRIC DETERMINATION. E. C. Cogbill, J. C. White, and C. D. Susano. Oct. 30, 1953. Decl. Jan. 11, 1954. 20p. Contract W-7405-eng-26. (ORNL-1644)

The amperometric titration of phosphate with uranyl acetate has been applied to the determination of phosphate in H_2SO_4 and HClO_4 solutions of U phosphates. Uranium is removed by cation exchange separation with Dowex-50. The relative standard deviation was 0.6% for solutions containing 65 to 150 mg of phosphate and 180 mg of U (as UO_2^{2+}) and having acid concentrations as high as 8M HClO_4 and 11M H_2SO_4 . (auth)

*1319

Atomic Energy Project, Univ. of Rochester
THE SEPARATION AND IDENTIFICATION OF MIXTURES OF C_{21} AND C_{19} STEROIDS BY PAPER CHROMATOGRAPHY. Leonard K. Axelrod. Oct. 29, 1953. 26p. Contract W-7401-eng-49. (UR-288)

Twenty-five steroids including representatives of the $C_{21}O_3$, $C_{21}O_2$ and $C_{19}O_2$ groups in a mixture have been separated in decalinformamide, cyclohexene-formamide, methylcyclohexane-propylene glycol, and methylcyclohexane-1,3-butanediol solvent systems. Each group may be chromatographed separately or all three groups together in a mixture. Spot tests for detecting these steroids on paper chromatograms have been developed, among which are hydriodic acid saturated with I, dinitrophenylhydrazine, fuming H_2SO_4 (15% free SO_3), alkaline *m*-dinitrobenzene, and $SbCl_5$. Five micrograms of compound may be detected on paper chromatograms. The use of ultraviolet absorption spectra of the H_2SO_4 chromogens add to the qualitative identification of these steroids. The relative chromatographic mobilities of the compounds are discussed in relation to functional groups and the steroid nucleus and their relative solubilities in the stationary and mobile phases of the solvent systems. (auth)

1320

INTERNAL ELECTROLYTIC ANALYSIS IN WHICH AN OXIDATION-REDUCTION ELECTRODE OF THE SOLUTION TYPE IS EMPLOYED AS ANODE. Ishimaru Saburo and Mizoguchi Shichiro. Translated from J. Chem. Soc. Japan, Pure Chem. Sec. 73, 267-70(1949-52). 8p. (AEC-tr-1756)

Electrolytic determinations of Cu, Ag, and Bi were made with $Pt/V^{+2}, V^{+3}$ as the anode. The complete apparatus is shown, and the method of procedure is outlined. (J.S.R.)

1321

DETERMINATION OF MANGANESE, SODIUM, AND URANIUM BY RADIOELEMENTS. C. Fisher and J. Beydon (Commissariat à l'Énergie Atomique). *Bull. soc. chim. France* 11 Journée microanal. C.102-3(1953). Nov.-Dec. (In French)

Mn, Na, and U can be determined by radiometric analysis at concentrations as low as 10^{-8} g. Mn must be separated from Si and Sc before the count is made. The determination of U is simpler if it is collected on a precipitate of $Fe(OH)_2$. (J.S.R.)

1322

COLORIMETRIC DETERMINATION OF NIOBIUM IN TITANIUM ALLOYS. George Norwitz, Maurice Codell, and Frank D. Verderame. (Frankford Arsenal, Philadelphia). *Anal. Chim. Acta* 9, 561-74(1953). Dec. (In English)

The determination of Nb in Nb-Ti alloy is an extremely difficult matter. In the method proposed the sample is dissolved in a mixture of hydrofluoric and nitric acids, the solution evaporated to a small volume, and boric acid added. Two tannic acid separations are then made to separate the Nb from the bulk of the Ti. The Nb is determined colorimetrically by the thiocyanate method using a water-acetone medium. A study was made of the possible interference of elements that might be present in Ti alloys. It was found that the presence of Ta causes two opposing tendencies. Ta can cause high results for Nb because it forms a complex with thiocyanate which is visually colorless but shows some absorption. Ta can cause low results for Nb by hindering the development of the Nb color. The resultant effect of the Ta depends upon the amount of Ta present, the amount of Nb present and the ratio of Ta to Nb. Other elements that might be present in Ti alloys do not interfere with the method. The procedure is designed for Ti alloys containing 0.05 to 10% Nb. The method is reasonably rapid. Six determinations can be finished in two days. The method should be applicable to many other materials besides Ti alloys. (auth)

1323

COLORIMETRIC DETERMINATION OF CARBON IN TITANIUM. Maurice Codell, George Norwitz, and Orien W.

Simmons (Frankford Arsenal, Philadelphia). *Anal. Chim. Acta* 9, 555-60(1953). Dec. (In English)

A method is proposed for the colorimetric determination of C in Ti. In the method the sample is dissolved in a mixture of sulfuric and fluoboric acids, and nitric acid is added to dissolve the TiC. The solution is boiled and filtered, and the yellow coloration from the nitrated organic complex is read with a spectrophotometer. A spectrophotometric study of the color was made. A comparison was made between the colorimetric determination of C in Ti and the colorimetric determination of C in steels. The proposed method is rapid and is readily adaptable to the determination of C in a large number of samples at one time. The procedure is designed for Ti containing up to 0.7% C. None of the elements encountered in "commercially pure" Ti metal interferes. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1324

INTERFERENCE MEASUREMENT IN THE METASTABLE β -YOF. F. Hund (Technische Hochschule, Stuttgart, Germany). *Z. anorg. u. allgem. Chem.* 273, 312-18(1953). (In German)

The structural relations of the metastable β YOF to the temperature-stable α YOF are described. In the metastable β YOF the irregular lattice perturbation, caused by heat vibration, was determined by an absolute measurement to be $2.56 \pm 0.28 \times 10^{-16}$ cm², while the true temperature disturbance, calculated theoretically by an approximation method from the heat motion of the lattice, was $0.55 \pm 0.28 \times 10^{-16}$ cm². The greater value of the measured irregular lattice perturbation was explained by the statistical displacement and mixing of the single lattice "bricks", which, by cooling the compound to its ideal point layer, gives rise to the low-temperature-stable α phase. The incipient deformation of the cubic metastable β phase was determined to be $da/a = 0.15 \pm 0.01\%$. The x-ray measured primary particles had a size of 1294 ± 148 kX. (tr-auth)

FLUORINE AND FLUORINE COMPOUNDS

1325

Cornell Univ.
STRUCTURES OF FLUOROCARBONS, ELEMENTARY BORON, AND BORON COMPOUNDS. X-RAY STUDIES OF THREE CRYSTALLINE FLUOROCARBONS SHOWING ROTATIONAL DISORDER. P. J. Schapiro and J. L. Hoard. Jan. 11, 1954. 11p. Contract AT(30-1)-878. (NYO-3946)

X-ray investigations of three fluorocarbons, $C_4Cl_4F_4$, C_6F_{10} , and $C_8Cl_4F_8$, believed to contain cyclobutane ring systems, show that in every case molecular rotation occurs in the crystalline phase stable just below the melting point. $C_4Cl_4F_4$ crystallizes in a body-centered lattice with $a = 7.95 \pm 0.10$ Å and one molecule per lattice point. $C_8Cl_4F_8$ is face-centered cubic with $a = 11.07 \pm 0.10$ Å and one molecule per lattice point. Both compounds show the highest possible x-ray symmetry, $m\bar{3}m$. C_6F_{10} is hexagonal with $a = 6.95 \pm 0.10$ Å, $c = 11.2 \pm 0.10$ Å, has two molecules per lattice point, and shows the Laue symmetry $6/mmm$. All experimental data for Bragg intensities, diffuse scattering, and physical properties of the crystals support the conclusion of molecular rotation. The possible existence of condensed cyclobutane rings in C_6F_{10} and $C_8Cl_4F_8$ is neither confirmed nor denied. (auth)

GRAPHITE

1326

DYNAMICS OF THE GRAPHITE LATTICE. Herbert B. Rosenstock. (U. S. Naval Research Lab., Washington). *J. Chem. Phys.* 21, 2064-9(1953). Nov.

The distribution of frequencies of normal vibrations in the graphite lattice has been obtained in closed form for low temperatures in the two-dimensional approximation for the values $(\alpha, \beta, 0)$ and $(\alpha, \beta, \alpha/2)$ of the force constants (α, β, γ) for nearest, second-nearest, and third-nearest neighbors. The frequencies run from 0 to a finite value ω_{\max} , with two logarithmic peaks in their density. The specific heat has been calculated for two special sets of force constant ratios. Deviations from T^2 dependence set in at temperatures, much lower than predicted by Debye theory. Comparison with experiment leads to a numerical value for $\theta = \hbar \omega_{\max}/k$, from which ω_{\max} , and therefore also α and one of the macroscopic elastic constants, c_{44} , may be calculated. θ and ω_{\max} appear very sensitive to the assumed force constant ratios, c_{44} less so. (auth)

LABORATORIES AND EQUIPMENT

*1327

Hanford Works
SANDBLAST DECONTAMINATION OF STAINLESS STEEL. L. E. Katner. Oct. 7, 1953. 17p. Contract W-31-109-Eng-52. (HW-29576)

Comparative decontamination tests based on stainless steel contaminated with Hanford U dissolver solution show that sandblasting is considerably more thorough than the usual chemical method. It is evident that sandblasting not only reduces the decontamination time but also removes 99+% of the contamination. (auth)

RADIATION CHEMISTRY

1328

Columbia Univ.
ABSOLUTE QUANTUM YIELDS FOR DISSOCIATION OF IODINE IN INERT SOLVENTS. Frederick W. Lampe and Richard M. Noyes. Dec. 7, 1953. 22p. Contract AT(30-1)-1314. (NYO-3884)

When I atoms are produced in air-saturated solutions containing enough allyl iodide, they react quantitatively with the production of a molecule of I from each atom. This observation was used to measure the efficiency with which light of 4358 Å causes dissociation of molecular I and allyl iodide into fragments that escape their original partners. Data in hexane, CCl_4 , and hexachlorobutadiene-1,3 suggest that the quantum yield for escaping fragments is greatly diminished as the molecular weight of the solvent increases. These observations are regarded as the best present support for the idea that the fragments from a photochemical dissociation are produced in a "cage" of surrounding solvent molecules from which they must escape in the initial act if they are to avoid recombination. (auth)

1329

STUDY OF THE RADIOLYSIS OF SOLUTIONS DILUTED WITH DIPHENYLPICRYLHYDRAZYL (DPPH) IN ORGANIC SOLVENTS. A. Chapiro (Laboratoire de Chimie physique, Paris, France), J. W. Boag, M. Ebert, and L. H. Gray (Hammersmith Hospital, London, England). *J. chim. phys.* **50**, 468-81(1953). Sept. (In French)

The decoloration of solutions diluted with DPPH by the influence of x and γ rays permits a study of the radiolysis of chloroform. The influence of DPPH concentration on the speed of the reaction is interpreted with the aid of simple theories. The chemical yield per unit energy absorbed does not depend on the wave length of the radiations studied: γ rays and x rays of 1.2 Mev, 190 kev, and 37 kev. The study of the reaction kinetics leads to the conclusion that for weak intensities the free radicals produced by the radiation are not uniformly distributed throughout the irradiated volume. The decoloration of DPPH solutions is a very sensitive re-

action and finds several applications in the chemical dosimetry of ionizing radiations. (tr-auth)

1330

OXIDATION OF INDIGO CARMINE IN AQUEOUS SOLUTION BY γ RADIATION. L. Mongini and E. L. Zimmer. *J. chim. phys.* **50**, 491-4(1953) Sept. (In French)

The suitability of indigo carmine as a γ -ray detector is discussed. Data are presented on the changes of concentration as a function of irradiation time. Additional material is given on measuring techniques, preparation of solutions, and the oxidation characteristics of indigo carmine in aqueous solutions. The probable mechanism of the irradiation effect is noted briefly. (K.S.)

RARE EARTHS AND RARE-EARTH COMPOUNDS

1331

THE PURIFICATION OF ERBIUM SALTS. O. M. Hilal (Univ. of Alexandria, Egypt). *Z. anorg. u. allgem. Chem.* **273**, 241-6(1953). (In German)

For the determination of Er from an oxide mixture which contains Y and Yb and a smaller amount of Er, many methods have been used. The fractional precipitation of the metallic hydroxide from an aqueous solution with ammonia appears to be the best of the investigated methods. (tr-auth)

SEPARATION PROCEDURES

*1332

Stanford Research Inst.
ENGINEERING AND ECONOMIC EVALUATION OF COUNTERCURRENT AND FIXED BED ION EXCHANGE PROCESSES. TECHNICAL REPORT NO. 7. Nevin K. Hiester, Raymond K. Cohen, and Russell C. Phillips. June 26, 1953. 51p. Contract AT(11-1)-110, Report No. 32. (AECU-2739)

The most economical ion exchange techniques for the separation or removal of ionic components were determined. Three modes of contacting the resin and solution were considered; in a fixed bed of resin, in an intermittent mixer-settler-type device, and in a continuous countercurrent column. The fixed-bed operation involves the conventional procedure of cyclic saturation and elution of the stationary resin. The mixer-settler is composed of a number of equilibration stages and solution reservoirs and is divided into saturation and elution sections. The continuous, countercurrent column involves moving beds of resin in two columns, one for saturation and another for elution. The only simple, yet precise, methods presently available for the design of all three processes apply to the exchange of trace components. In the case of the removal of gross ions, approximate procedures were used for the calculation of moving-bed and fixed-bed units. The procedures are given by which the optimum economic design of each process was determined over a range of process specifications. Although these specifications are hypothetical, they were selected to provide realistic design problems. The relative costs of the processes, including buildings and all auxiliary equipment, are presented for trace ion separation, trace ion removal, and gross ion removal. The effect on the cost of product specifications and throughput is indicated. (auth)

1333

SELF-DIFFUSION OF CATIONS IN HETERO-IONIC CATION EXCHANGERS. B. A. Soldano and G. E. Boyd (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **75**, 6107-10 (1953) Dec. 20.

Diffusion coefficients, D , and activation energies, E_{act} , for the diffusion of Na, Zn, and La ions were measured experimentally and compared with corresponding values for the same ions in their pure (i.e., homo-ionic) exchanger salt forms. In general, the diffusion rate of the more mobile

cation was lowered, and that of the less mobile ion was increased. An interpretation of the observed diffusion coefficients was based on the equation from absolute reaction rate theory, $D = ed^2(kT/h) \exp(\Delta S^\ddagger/R) \exp(-E_{act}/RT)$, according to which changes in D are governed by changes in E_{act} and ΔS^\ddagger , the entropy of activation. An explanation of the magnitudes of the observed activation energies and derived entropies is proposed based on the hydration of the cations in the exchanger, on the extent of their association with the bound anionic exchange groups, and on the degree of hydration of the activated complex for diffusion. (auth)

1334

SELF-DIFFUSION OF WATER MOLECULES AND MOBILE ANIONS IN CATION EXCHANGERS. G. E. Boyd and B. A. Soldano (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **75**, 6105-7(1953) Dec. 20.

Coefficients, D , and activation energies, E_{act} , for the self-diffusion of H_2O^{18} in variously cross-linked Dowex-50 type cation exchangers were measured and compared with corresponding quantities reported for pure water. The observed values for D_{H_2O} , E_{act} , and the entropy of activation, ΔS^\ddagger , for diffusion in exchangers suggested that, as in pure water, the unit of transport is the single H_2O molecule. The lower ΔS^\ddagger values found were attributed to the further breaking of the structure of water in exchangers by the ions present therein. A method for distinguishing between free and bound water in exchangers was explored using the fact that two distinct rate processes involving H_2O^{18} could be measured in the Cr(III) cation exchanger salt-form. The diffusion of bromide ion, measured using 35.9 h. Br^{82} as a tracer, was found to be slower than for H_2O^{18} , but more rapid than for the self-diffusion of singly charged cations. (auth)

1335

SELF-DIFFUSION OF CATIONS IN AND THROUGH SULFONATED POLYSTYRENE CATION-EXCHANGE POLYMERS. G. E. Boyd and B. A. Soldano (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **75**, 6091-9(1953) Dec. 20.

Coefficients, D , for the self-diffusion of nine cations in sulfonated polystyrene-divinylbenzene type cation exchangers were determined as a function of temperature and polymer cross-linking. A strong dependence of D on the formal cationic charge was observed at all cross-linkings: In Dowex-50 at 25° values of 2.88×10^{-7} for Na^+ , 2.89×10^{-8} for Zn^{+2} , 3.18×10^{-9} for Y^{+3} , and 2.15×10^{-10} for Th^{+4} ion were observed. Increased cross-linking, measured by the nominal divinylbenzene (% DVB) content, resulted in a sharply lowered self-diffusion rate. The coefficient at 25° for Zn^{+2} in 1% DVB was 1.06×10^{-8} compared with 2.63×10^{-9} cm^2/sec in a 24% DVB exchanger. Activation energies, E_{act} , which were temperature but not charge dependent, increased with cross-linking from ca. 4700 to 10,000 cal/mole. A qualitative interpretation of the variations of D was attempted based on absolute reaction rate theory modified by Barrer to explain observed temperature variations of E_{act} . The derived entropy of activation, ΔS^\ddagger , was regarded as the resultant of two opposing effects: (a) a positive contribution from the disturbance created in its environment by the diffusing ion; and (b) a negative contribution from the electrostriction of water accompanying the separation of charge in forming the activated complex. (auth)

1336

SELF-DIFFUSION OF ANIONS IN STRONG-BASE ANION EXCHANGERS. B. A. Soldano and G. E. Boyd (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **75**, 6099-104 (1953) Dec. 20.

Measurements of self-diffusion coefficients, D , for chloride, bromide, iodide, bromate, tungstate and orthophosphate anions in a strong-base anion exchanger (Dowex-

2) gave values between 4.6×10^{-7} and 5.7×10^{-8} cm^2/sec at 25° . The temperature variations of D between 0.2 and 25° gave activation energies from 6000 to 8800 cal/mole. The dependence of D on ionic charge and ion exchange polymer cross-linking was not so pronounced as found previously for cations in cation exchangers. The self-diffusion of bromide ion in differently substituted quaternary ammonium type exchangers of constant polymer cross-linking indicated that the size of the exchange group was more important than its polarity in determining permeation rates. The self-diffusion of anions in anion exchangers was considered to occur with a "zone of activation." Generally, positive, net entropies of activation were found. Because of the relatively small hydration of the mobile anions and of the structurally-bound cationic exchange groups in anion exchangers, the sometimes appreciable negative contributions to the activation entropy observed with cation exchangers were absent. (auth)

SPECTROSCOPY

1337

Los Alamos Scientific Lab.

THE INFRARED SPECTRA OF SOME PHENLOXAZOLES AND RELATED COMPOUNDS. Virgil L. Koenig, F. N. Hayes, Betty S. Rogers, and J. D. Perrings. [1953] 63p. Contract [W-7405-Eng-36]. (AECU-2778)

The infrared absorption spectra of a number of halogen-, methyl-, and methoxy-substituted derivatives of 2,5-diphenyloxazole and of some precursors of the oxazole derivatives in the form of derivatives of acetophenone were determined. Results are presented in tabular form. (C.R.)

TRACER APPLICATIONS

1338

Atomic Energy Project, Univ. of Calif., Los Angeles
THE HYPOBROMITE AND HYPOCHLORITE OXIDATION OF AMMONIUM HYDROXIDE, HYDRAZINE, AND HYDROXYLAMINE. Richard F. Riley, Esther Richter, Mary Rotheram, Norman Todd, Lawrence S. Myers, Jr., and Ralph Nusbaum. Issued Jan. 15, 1954. 15p. Contract AT-04-1-GEN-12. (UCLA-277)

The alkaline oxidation of ammonium salts with hypochlorite or hypobromite gives N containing a small percentage of nitrous oxide. Under these conditions hydrazine gives mainly N with very little nitrous oxide, while hydroxylamine reacts to give an appreciable amount of nitrous oxide. Ammonia containing N^{15} was oxidized in the presence of hydrazine or hydroxylamine using insufficient oxidant to complete the reaction. The residual hydrazine or hydroxylamine was isolated and found to contain no excess N^{15} suggesting that the paths of formation of N_2 and nitrous oxide from ammonia do not involve hydrazine or hydroxylamine as intermediates. (auth)

URANIUM AND URANIUM COMPOUNDS

1339

Argonne National Lab.

THE HALF LIFE OF U^{232} . P. A. Sellers, C. M. Stevens, and M. H. Studier. Nov. 1953. Decl. Jan. 11, 1954. 3p. Contract W-31-109-eng-38. (ANL-WMM-1156)

The half life of U^{232} has been determined to be 73.6 ± 1.0 yr by a method involving isotopic dilution, mass spectrometric analysis, and determination of the specific activity of the diluted sample by conventional weighing and counting techniques. (auth)

*1340

Oak Ridge National Lab.

THE DENSITY OF URANYL SULFATE SOLUTIONS AND THE DETERMINATION OF URANIUM CONCENTRATION

BY DENSITY MEASUREMENTS. J. E. Lee, Jr., R. Rowan, Jr., C. D. Susano, and O. Menis. June 18, 1952. Decl. Jan. 11, 1954. 25p. Contract W-7405-eng-26. (ORNL-1332)

A study of the density of aqueous UO_2SO_4 solutions is described, which has had as its primary purpose the development of an analytical method for the determination of U in relatively dilute solutions of this salt. These solutions contain trace amounts of contaminating elements. The presence of small amounts of free H_2SO_4 and moderate variations in the temperature at which density measurements are made can be compensated for by the use of equations provided for the calculation of U concentration. (auth)

*1341

Oak Ridge National Lab.

THE CHEMISTRY OF URANIUM(VI) ORTHOPHOSPHATE SOLUTIONS. PART 2. THE SOLUBILITY OF URANIUM(VI) ORTHOPHOSPHATES IN PHOSPHORIC ACID SOLUTIONS. J. M. Schreyer and C. F. Baes, Jr. June 30, 1953. Decl. Nov. 16, 1953. 38p. Contract W-7405-eng-26. (ORNL-1578)

The solubility behavior of uranium(VI) phosphates has been determined in aqueous solutions containing 0.001 to 15M total phosphate. Identification of the equilibrium solid phases has been made microscopically, chemically, and by x-ray-diffraction analysis. (For preceding report in series see AECD-3596.) (auth)

*1342

Oak Ridge National Lab.

THE CHEMISTRY OF URANIUM(VI) ORTHOPHOSPHATE SOLUTIONS. PART 3. THE SOLUBILITY BEHAVIOR OF $\text{UO}_2\text{HPO}_4 \cdot 4\text{H}_2\text{O}$ IN PERCHLORIC ACID SOLUTIONS. C. F. Baes, Jr. and J. M. Schreyer. July 1, 1953. Decl. Nov. 16, 1953. 52p. Contract W-7405-eng-26. (ORNL-1579)

The solubility behavior of $\text{UO}_2\text{HPO}_4 \cdot 4\text{H}_2\text{O}$ in perchloric acid solution has been determined as a function of the uranyl perchlorate, phosphoric acid, and hydrogen ion concentrations. These results, as well as those in pure phosphoric acid solution (ORNL-1578), have been interpreted in terms of the formation of 4 complexes in solution: $\text{UO}_2\text{H}_2\text{PO}_4^+$, $\text{UO}_2\text{H}_3\text{PO}_4^{++}$, $\text{UO}_2(\text{H}_2\text{PO}_4)_2$, and $\text{UO}_2(\text{H}_2\text{PO}_4)_2(\text{H}_3\text{PO}_4)$. (For preceding report in series see ORNL-1578.) (auth)

1343

EFFECT OF HYDROGEN CHLORIDE GAS ON U_3O_8 . B. I. Božić and O. Gal (Technischen Hochschule, Belgrade, Yugoslavia). *Z. anorg. u. allgem. Chem.* 273, 84-90(1953). (In German)

The investigation of the chlorination of U_3O_8 with dry HCl gas has shown that the chlorination proceeds readily at comparatively low temperatures and is complete in 3 hr at 1200°. The reaction product is UO_2Cl_2 which is soluble in water. Some loss occurs from the thermal decomposition of UO_2Cl_2 or from reversible decomposition reactions. From these investigations it appears that this process might offer an economic possibility for the extractions of U ores. (tr-auth)

ENGINEERING

AEROSOLS

*1344

Atomic Energy Project, Univ. of Rochester

A NEW DESIGN OF FILTER HOLDER FOR DUST SAMPLING. K. E. Lauterbach. Oct. 15, 1953. 7p. Contract W-7401-eng-49. (UR-286)

A new quick-acting filter holder is described for air sampling with molecular filter disks. The experimental

model has proved to be satisfactory for holding both molecular filters and fiber filters, especially those of the thin sheet variety. (auth)

HEAT TRANSFER AND FLUID FLOW

1345

Los Alamos Scientific Lab.

ON THE SUPERFLUID DYNAMICS OF LIQUID HE II. J. G. Dash. [1953]. 23p. Contract [W-7405-eng-36]. (AECU-2786)

Some implications of the coöperative cluster model are explored. Supercritical flow of liquid He II through capillaries is discussed and compared with experiment, as a test of the theory and as a means for deducing some information on the postulated wall-friction mechanism. The general flow characteristics of the actual mobile film of He II and the present film model flowing under the influence of gravity are found to be in substantial agreement. (auth)

*1346

Knolls Atomic Power Lab.

TEMPERATURE DISTRIBUTION IN THE WALLS OF A SLOT AS THE LEVEL OF A LIQUID IS RAPIDLY RAISED IN THE SLOT. D.P. Timo. Sept. 15, 1953. 40p. Contract W-31-109-Eng-52. (KAPL-989)

The temperature distribution in the bounding walls of a slot or annulus, as the level of a liquid is rapidly raised in the slot, may be found from dimensionless curves presented in this report. The particular case of an initially linear temperature distribution in the slot walls is considered. A curve for determining the distance above the bottom of the slot at which the liquid freezes is also presented. (auth)

*1347

Oak Ridge National Lab.

THE EFFECT OF VISCOSITY UPON THE PRESSURE DISTRIBUTION FOR SWIRLING FLOW THROUGH A RIGHT CIRCULAR CYLINDER. R. H. Wilson. Issued Aug. 25, 1953. 83p. Contract W-7405-eng-26. (ORNL-1598)

An investigation was made of the effect of viscosity and liquid shear on the pressure and velocity distribution in a vortex associated with swirling flow. Three liquids (water and two hydrocarbon oils) were employed to show the influence of viscous forces on the swirling flow in a right circular cylinder. Radial pressure distribution measurements were made with each of these liquids for various flow conditions, and data are analyzed to determine the effect of viscosity on the swirling flow within the cylindrical vessel. The equipment and experimental procedures used are described, and data on experimental results are presented in tabular form. (60 references.) (C.H.)

MATERIALS TESTING

*1348

Battelle Memorial Inst.

THE PERFORMANCE OF WATER-LUBRICATED SLEEVE BEARINGS. R. W. Dayton, C. M. Allen, and H. A. VanDyke. June 19, 1953. 42p. Contract W-7405-eng-92. (BMI-843)

The performance of water-lubricated bearings, made of a wide variety of materials, has been investigated. The results indicate that the best performance is obtained with very hard materials: ceramic bearings and sintered carbide journals. The methods of testing, description of equipment, selection of materials, and results of tests on a variety of materials are presented. Data on Graphitar 14 bearings are given for comparison. (auth)

*1349

New York Operations Office, AEC

NON-DESTRUCTIVE TESTING BY IMPEDANCE ANALYSIS. Richard Hochschild. June 5, 1953. 76p. (NYO-3579)

An unclassified review is made of new developments in eddy-current testing arising out of the programs of the AEC but applicable to a variety of industrial problems. Emphasis is on a graphic but nonmathematical treatment of the principles of testing for specific physical properties (such as flaws, impurities, or wall thickness) to the exclusion of other variables in the test piece by methods of impedance analysis and specialized coil design. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

1350

Massachusetts Inst. of Tech.

THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. Oct. 30, 1953. 36p. Contract AT(30-1)-956. (NYO-3679; MITS-21)

The adsorption on barite from aqueous solutions of lauric acid is a slow process. This slow approach to equilibrium is independent of the kind of barite used (mineral or synthetic) or the concentrations of sulfate, Ba, and laurate ions in solution. The pH, the ionic strength, and the temperature of the solutions in contact with the mineral also seem not to affect the attainment of equilibrium. The adsorption of lauric acid on AgI will be determined by oxidation of labeled lauric acid to CO₂ and its quantitative transfer to a counter. No technique has been successful in remedying the irreversibility occurring in the titration of Ag₂S precipitates with AgNO₃ and Na₂S. The effects of Cu, Zn, Ba, CN⁻, and pH on the electrophoretic mobility of fine sphalerite particles were investigated. Cu and Zn reverse the sign of the sphalerite surface charge in alkaline solutions of NaHCO₃. In solutions with constant CuCl₂ concentration (10⁻⁴ mole/l) but varying pH, the mobility of the sphalerite reached a minimum at pH 7.7. At a CuCl₂ concentration of 10⁻³ mole/l, a blue precipitate of Cu(OH)₂ settled out at pH 6.9 and 9.1. The presence of KCN does not change the mobility as long as excess CuCl₂ is present. Cu can be desorbed from sphalerite by NH₄OH with the degree of desorption dependent on pH. Ethylenediamine desorbs Cu by forming the chelate. The course of the reaction is plotted. The adsorption of xanthate on pyrite decreases with pH⁻. The pH affects the mobility with the pyrite becoming neutral or positively charged at pH 3. Increase in pH increases the negative surface charge until a maximum is reached at pH 6.5. Pyrite is more negative in the presence of sulfide ions than with hydroxide alone. The surface charge is positive in the presence of ferric ions. Cu⁺ and Ca⁺⁺ decrease the mobility of pyrite. A description is given of the design of an apparatus which will give impacts with objects weighing less than 100 g at such velocities that the kinetic energies of the objects may have the same range of values as the impacting hammers that weighed from 100 to 600 g. Maximum strain energy values were determined for a mild steel bar. The principles of operation in a vibratory ball mill are discussed. (For preceding report in series see NYO-3678.) (J.S.R.)

GEOLOGY AND MINERALOGY

1351

Lamont Geological Observatory, Columbia Univ.

STUDIES ON THE LEAD METHOD OF AGE DETERMINATION. [PART] 1. J. Lawrence Kulp, W. R. Eckelmann, H. R. Owen, and G. L. Bate. [1953] 17p. (NYO-6199)

Ages of a number of radioactive minerals have been determined from Pb²⁰⁷/Pb²⁰⁶, Pb²⁰⁶/U²³⁸, Pb²⁰⁷/U²³⁵, and Pb²⁰⁶/Pb²¹⁰ ratios. Values obtained for minerals from classic localities agree well with those reported by other investigators. Major attention has been given to the anomalies of the ages of a given mineral computed from the various possible isotope ratios. The development of the Pb²¹⁰ method adds greatly to the fund of data required to obtain accurate ages. The 206/210 age is essentially independent of U leaching of Rn leakage. The latter is a significant factor in 206/238 and 207/206 ratios and must be measured experimentally to evaluate ages from these ratios. It appears that throughout most of the span of geologic time the 207/235 and 206/210 ages are the most reliable. The 206/238 supersedes the 207/235 age in accuracy for very young minerals. The 207/206 age does not merit the reliability ascribed to it by earlier investigators. (auth)

1352

Division of Raw Materials, AEC

PRELIMINARY REPORT OF RECONNAISSANCE IN THE CAMERON AREA, ARIZONA. Floyd J. Williams and Donald C. Barrett. Issued June 1953. 10p., 1 illus. (RME-4002)

An airborne reconnaissance was conducted in eastern Coconino Co., Ariz. The area flown lies mainly in the valley of the Little Colorado River between Leupp and a point about 15 miles north of Cameron. Triassic horizons, the Shinarump and Chinle, were the U-bearing formations in the area. All production at the date of this report had come from the Chinle. Anomalies found in the Shinarump were not promising. Chinle U deposits resemble Colorado Plateau deposits but contain very little V and a large assortment of rarer trace elements. The deposits are usually associated with carbonaceous matter around logs or carbonaceous matter disseminated in thin beds. (auth)

1353

Division of Raw Materials, AEC

PRELIMINARY REPORT ON RELATION OF STRUCTURE TO URANIUM MINERALIZATION IN THE TODILTO LIMESTONE, GRANTS DISTRICT, NEW MEXICO. Philip C. Ellsworth and Arthur Mirsky. Issued Sept. 10, 1952. 15p. (RME-4020)

Investigation of the structure of the Todilto limestone in the Grants district indicates a genetic relationship between the Todilto folds and joints resulting from the Zuni uplift. Drill-hole data from three test areas indicate that most ore bodies in the Todilto lie on anticlines or synclines, the larger ones on anticlines. The larger ore bodies are elongate in a manner that suggests control by a conjugate joint system. Finally, ore bodies appear to trend in general conformity with the structures. In shallow areas a fairly reliable structure map may be drawn before drilling begins by utilizing rim contact elevations. Drilling a 400-ft grid should indicate favorable structure and permit location of close-spaced holes in these areas. (auth)

1354

Division of Raw Materials, AEC

DRILLING IN THE HAPPY JACK MINE AREA, WHITE CANYON, SAN JUAN COUNTY, UTAH. Leo J. Miller. Issued Aug. 18, 1952. 14p. (RME-4039)

Ore in the Happy Jack area is confined to the Triassic Shinarump conglomerate which lies above the Moenkopi formation and below the Chinle formation. It can be classified as a typical Cu-U sandstone deposit. The Shinarump consists of fine- to coarse-grained sandstone which is white weathering to buff in color. The grains are angular to subrounded and range from poor to well cemented with gypsum, calcite, or silica. Pebbles, where present, are

quartz or quartzite. The preliminary work in this area indicated that stream channels within the Shinarump conglomerate controlled the ore deposition. Channel trends were contoured on the basis of outcrop information. It was necessary to delineate the channels by diamond drilling. Twenty-six holes were completed, totalling 3445.2 ft; 42% of the holes located ore. Drilling was conducted on three general channels: the Gonaway, the Sunrise, and the Happy Jack. The program was successful in many respects. Channel trends were extended beyond the outcrop, and a sizable orebody was outlined. It was determined that channels were the major Shinarump ore control, and lithologic traps, combined with carbonaceous matter, comprised the principal "intra-channel" controls. (auth)

1355

Division of Raw Materials, AEC
URANIUM OCCURRENCE AT THE CHEROKEE MINE,
QUEEN MINERAL RANCH, GILPIN COUNTY, COLORADO.
Raymond C. Derzay. Jan. 1953. 9p. (RME-4041)

Preliminary reconnaissance, sampling, and surface examination of the Cherokee mine on the Queen Mineral Ranch indicated a potential U deposit. Hand-picked dump samples containing pitchblende assayed from 0.40 to 1.97% U_3O_8 . The mine includes an adit 280 ft long with a 24-ft winze, and a shaft 125 ft deep with drifts of about 50 ft east and west. The country rock is predominantly pre-Cambrian quartz-biotite schist and schistose gneiss, with lenses and injections of pegmatitic materials. A quartz-monzonite porphyry dike, striking northward, is just west of the Cherokee mine, and another, striking northeasterly, is east of the American Girl. These dikes are thought to be factors in the mineralization of the district. There are two strong east-west, near-vertical veins in the immediate area, the American Girl-Cherokee and the Annie. Principal ore minerals are chalcopyrite, galena, pyrite, and sphalerite, and the gangue consists of quartz and altered schist. Uranium occurs as pitchblende in veinlets from $1/32$ to 2 in. wide. (auth)

1356

Geological Survey
EXTRACTION OF URANIUM FROM THE RED DESERT
COAL OF WYOMING. Irving A. Breger, Robert Meyrowitz,
and Jesse J. Warr, Jr. Dec. 1953. 21p. (TEI-372)

The extraction of U from the subbituminous coal of the Red Desert, Wyo., was found to be somewhat more difficult than from the lignite of S. Dak. Batch extraction of the Wyo. coal with 6N HCl leads to the solution of almost 90% of its U. Recovery of U is independent of the particle size of the coal between -4 and -20 mesh, and is accompanied by the solution of approximately 70% of the inorganic constituents (ash) of the coal. The extract contains a concentration, along with U, of several valuable elements such as Mn, Ce, and V which are present in the coal. Preliminary treatment of the Red Desert coal with 6N acid would necessitate the handling of large volumes of coal. The acid extract from this process would, if burned, produce an ash containing about a tenfold concentration of U over that present in the original coal. Yields of char and tar are approximately 15% lower with extracted coal than with original coal. An alternate scheme for recovery of U from the Red Desert coal might involve carbonization and the production of tar as an industrial raw material. If this approach is followed, the char will contain nearly a twofold concentration of U over that in the original coal. Use of the char as a fuel will allow recovery of U from its ash. If the char is to be extracted before use, recovery of U will be only approximately 55%. It is possible that some of the U in the coal may be reduced during retorting to UO_2 , which is quite insoluble in 6N HCl. Ultimate choice of process for

the recovery of U from the Red Desert coal will depend upon economic factors. It is clear that U can be recovered from low rank coal or from retort char in high yield. (auth)

1357

CONCENTRATION OF URANIUM AND LEAD AND THE ISOTOPIC COMPOSITION OF LEAD IN METEORITIC MATERIAL. C. Patterson and H. Brown (Calif. Inst. of Tech., Pasadena), G. Tilton (Carnegie Institution, Washington), and M. Inghram (Univ. of Chicago and Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 92, 1234-5 (1953) Dec. 1.

The cosmic abundance of Pb and U have been determined by studying the Pb and U contents of meteoritic materials. Pb is found to be present to 8×10^{-3} atom/10,000 atoms of Si, and U to 1×10^{-4} atom/10,000 atom of Si. The new value for Pb removes the hump in the cosmic abundance curve in the 206 to 208 mass region. The relative primordial abundances of Pb isotopes of mass 204, 206, 207, and 208 are found to be 1:9.4:10.3:29.2, respectively. (auth)

METALS AND METALLURGY

*1358

Knolls Atomic Power Lab.
THE PRECISION DETERMINATION OF LOW CONCENTRATIONS OF CARBON IN METALS. Leonard P. Pepkowitz and William D. Moak. [Dec. 1953] 14p. Contract W-51-109-Eng-52. (AECU-2776)

An extremely simplified apparatus is described which is capable of performing the analysis of C in metals with a precision equivalent to that reported by other workers using complicated high-vacuum equipment. The method is applicable to a variety of metals besides Fe and steels. Mn, Mo, Cu, Pb, Ti, and Sn have been analyzed for C with a mean deviation of $\pm 0.0002\%$. On National Bureau of Standards standard steel samples a routine precision of $\pm 0.0002\%$ was obtained on C concentrations as low as 0.0028%, which was the lowest standard sample (NBS-131) available. The calculated lower limit of detection is 0.002 mg C, which in a gram sample is equivalent to 0.0002%. (auth)

*1359

Ames Lab.
ELECTRICAL RESISTIVITY AND HALL EFFECT IN SODIUM TUNGSTEN BRONZE. W. R. Gardner and G. C. Danielson. June 1953. 64p. Contract W-7405-eng-82. (ISC-350)

The electrical resistivity and Hall coefficient of Na-W bronze were measured as a function of Na concentration and temperature. Measurements were on single crystals with values of x between 0.58 and 0.90, where x is the x in Na_xWO_3 . The resistivity was linear with temperature in the range 125 to 300°K. The slope of the resistivity-temperature curve was also a minimum at x = 0.75 and had a value at that concentration of $9.45 \pm 0.60 \times 10^{-8}$ ohm-cm/°C. The residual resistivity was obtained by extrapolation of the resistivity to absolute zero. The residual resistivity was a minimum at x = 0.75 with a value of $1.25 \pm 0.10 \times 10^{-5}$ ohm-cm. The Hall coefficient varied less than 2% with temperature in the range 78 to 370°K. The Hall coefficient was inversely proportional to the Na concentration, varying from $-6.10 \pm 0.15 \times 10^{-4}$ cm³/coulomb at x = 0.584 to $-4.07 \pm 0.03 \times 10^{-4}$ cm³/coulomb at x = 0.897. The values for the Hall coefficient corresponded very nearly to one free electron for each Na atom. The minimum in the curve of resistivity as a function of Na concentration is due to an anomalous maximum in the electron mobility at x = 0.75. The reasons for this anomaly are not clearly understood. (auth)

*1360

Ames Lab.

ALUMINUM-VANADIUM SYSTEM. D. J. Kenney, H. A. Wilhelm, and O. N. Carlson. June 1953. 81p. Contract W-7405-eng-82. (ISC-353)

The nature of the Al-V system has been reported on the basis of thermal, microscopic, chemical, and x-ray evidence. The system contains six different solid phases at ambient temperatures, the four intermediate phases being peritectic in nature. Phase properties are summarized. The effect of composition upon density can be represented by a series of straight lines; the phase boundaries of the Al-V system seem to have some correlation with the discontinuities in slope of these straight lines. The addition of 20 wt. % Al has little effect on the hardness of either as-cast or cold-worked V. All hardness values observed for alloys containing up to 20 wt. % Al fell within 10 points of 60 on the Rockwell "A" scale. On the other hand, the addition of V to Al, has a profound effect on the hardness of the metal. The arc-melted alloys were cold pressed under 50,000 psi and reduced as much as 50% in thickness. A surprising feature of these alloys is that upon annealing in vacuo at 600°C for 24 hr the cold-worked metal became harder rather than softer. This is attributed to the development of a brittle peritectic compound (such as $Al_{11}V$) whose formation was suppressed during the rapid cooling of the arc-melting furnace. Aluminum will dissolve less than 0.5% V in solid solution, while V will dissolve up to 25% Al at room temperature. A maximum solid solubility of 35.3% Al in V occurs at 1670°C. Of the four intermediate phases, only δ (Al-V) shows an appreciable solid solubility range (47 to 55% V at 1360°C); this solubility range decreases with decreasing temperature and is almost negligible at room temperature. The solid solution phase is the primary phase to crystallize from the melt in all alloys containing more than 50% V. The crystal structure of each phase was pursued short of quantitative intensity measurements, and an unambiguous formula is provided for each of the intermediate phases. A correlation of the various phase structures indicates that a marked tendency toward super-lattice formation exists in the Al-V system. An Al atom exhibits a preference for four nearest V neighbors and four nearest Al neighbors arranged tetrahedrally. (auth)

1361

Institute of Engineering Research, Univ. of Calif., Berkeley
SOME OBSERVATIONS ON GRAIN BOUNDARY SHEARING DURING CREEP. Bernard Fazan, Oleg D. Sherby, and John E. Dorn. Nov. 15, 1953. 22p. Contract N7-onr-295, T. O. 2, Technical Report 32. (NP-5002)

Quantitative measurements of the contribution of grain-boundary shearing to the creep process were made for high-purity Al in the temperature range 610 to 747°K under a stress of 250 psi. The relative contribution of grain-boundary shearing to the total creep strain is shown to be independent of the test temperature, but, as revealed by McLean, it increases as the creep stress decreases. (auth)

1362

Bureau of Mines

MATERIALS SURVEY—BERYLLIUM. Bureau of Mines and Geological Survey. Sept. 1953. 182p. (NP-5011)

Statistics on production, imports, exports, stocks, and consumption of Be products are reported for the period 1935-51. A discussion of the important aspects of Be, general and specific information on production processes and facilities, a listing of World War II and current control measures applying to the ore, metal, alloys and compounds, and a selected bibliography are presented. (J.E.D.)

*1363

Pittsburgh Univ.

THE HEAT CAPACITY OF CADMIUM BETWEEN 12°K AND 320°K AND THE ENTROPY OF CADMIUM AT 25°C. PROGRESS REPORT FOR JULY 1, 1953—OCTOBER 1, 1953. C. A. Krier, R. S. Craig, and W. E. Wallace. Oct. 5, 1953. 10p. Contract AT(30-1)-647. (NYO-6154)

Results of heat-capacity measurements on Cd between 12 and 320°K are presented. The entropy of Cd at 25°C is evaluated. Constant-volume heat capacities and Debye characteristic temperatures for a number of temperatures between 12 and 300°K are given. (auth)

1364

Massachusetts Inst. of Tech.

THERMODYNAMICS OF METAL SOLUTIONS. TECHNICAL PROGRESS REPORT, SCOPE I. M. B. Bever, G. Scatchard, and C. Wagner. May 1, 1953. 5p. Contract AT(30-1)-1002, Scope I. (NYO-7001)

The calorimetric determination of stored energy in cold-rolled strips of a 75% Au-25% Ag alloy is briefly summarized. The heat of solution of the alloy at infinite dilution in liquid Sn at 240°C yielded a value of -1326 cal/g-atom of alloy with a standard deviation of 11 cal/g-atom. Results of an investigation of the stored energy in machined metal chips of the alloy are given. An equation for the vapor pressure of Zn from Ag-Zn alloys was obtained from spectroscopic measurements. The variability of the Ag/S ratio in Ag_2S was studied by means of electrochemical measurements. Silver sulfide coexisting with metallic Ag at 200°C contains an excess of 2.0×10^{-3} g-atom Ag/mole Ag_2S , whereas Ag_2S coexisting with liquid S has very nearly the ideal stoichiometric composition. The variability of the Ag/S ratio in beta Ag_2S at 160°C is of the order of 3×10^{-5} g-atom Ag/mole Ag_2S . A discussion is also given on the interdiffusion coefficient of Ag in alpha Ag_2S at 220°C. (For preceding period see NYO-925.) (J.A.G.)

1365

Massachusetts Inst. of Tech.

SOLID SOLUTIONS AND GRAIN BOUNDARIES. TECHNICAL PROGRESS REPORT NO. 17. SCOPE II. B. L. Averbach, M. Cohen, F. Herbstein, J. Hilliard, P. S. Rudman, and E. E. Underwood. Sept. 30, 1953. 4p. Contract AT(30-1)-1002, Scope II. (NYO-7036)

Negative results on diffuse-scattering measurements on Li-Mg alloys are briefly discussed. Precipitation kinetics in the Au-Ni system is described. This system has a miscibility gap with the maximum at approximately 840°C below which the parent face-centered cubic solid solution decomposes into 2 face-centered cubic solid solutions, one rich in Ni and the other rich in Au. The precipitation appears to take place primarily at the grain boundaries; thus it is necessary to determine the area of the grain interface per unit volume. A method for obtaining this information and the fraction transformed is given. The activation energies for diffusion and growth are discussed. (For preceding period see NYO-3819.) (J.A.G.)

1366

Armour Research Foundation

TITANIUM ALLOYS FOR ELEVATED TEMPERATURE APPLICATION. W. F. Carew, F. A. Crossley, H. D. Kessler, and M. Hansen. Aug. 1953. 82p. Contract AF-33(038)-22806. (WADC-TR-53-177)

Results on the following phases of the investigation of Ti alloys for elevated-temperature application are presented: homogeneity of the double-melted 8-lb ingots, density determinations, structural stability studies, creep-rupture testing, room- and elevated-temperature tensile testing, and an evaluation of the effect of exposure to air at elevated temperatures on stress-rupture properties.

Alloys for which experimental data are reported are: 2% Al, 4% Al, 6% Al, 8% Al, 8% Al-1% Si, 8% Al-1% Si, 8% Al-4% Mo, 6% Al-1, 3, and 5% Ta, 8% Al-1, 3, and 5% Ta, and 30% Mo. Homogeneity of the 8-lb ingots was generally good. The structures developed by the heat treatments used appeared to be stable under the conditions of creep-rupture testing. At 550°C for a service life of approximately 1000 hr, the results show that the alloys 6% Al-1% Si, 8% Al-1% Si, and 8% Al-4% Mo are superior in creep resistance to stainless steel, Type 410 (12.5% Cr-bal. Fe). Also, at 425°C and probably 550°C for 1000 hr service life, the 6% Al alloy is shown to have superior creep resistance to Type 410. Alloys 6% Al-1, 3, and 5% Ta and 8% Al-1, 3, and 5% Ta offer little, if any, advantage in rupture strength over their 6 and 8% Al binary counterparts at 550°C and are inferior to the 6% Al-1% Si alloy. Exposure to air at elevated temperatures for 100 hr appears to have little or no effect on the creep-rupture properties of the Ti-Al-base alloys. (auth)

1367

Tour, Sam, and Co., Inc.

RESEARCH AND DEVELOPMENT OF METHODS OF VAPOR DEPOSITED COATINGS FOR TITANIUM AND TITANIUM ALLOYS. FINAL TECHNICAL REPORT. Andre Styka. Dec. 4, 1953. 35p. Contract DA-30-069-ORD-860. (WAL-401/48/B-26)

Molybdenum was deposited on Ti by the decomposition of $\text{Mo}(\text{CO})_6$ in forty different runs. The optimum CO/H_2 ratio seems to be approximately 3/1. Techniques were developed which produced adherent Mo coatings. Maximum surface hardness was found to be in the neighborhood of 1400 DPH. Photomicrographs, showing microstructures of the Ti base metal and the Mo deposits, are included. Qualitative wear tests show that Mo coating on Ti and Ti alloys have excellent wear resistance. X-ray-diffraction examination indicated some carbides present in the Mo coatings as deposited from the vapors of the carbonyl. (auth)

1368

THE STRUCTURE AND CORROSION OF ALUMINUM-MAGNESIUM AND ALUMINUM-ZINC-MAGNESIUM [ALLOYS]; MECHANISM OF INTERCRYSTALLINE CORROSION AND STRESS CORROSION. [Structure et corrosion des alliages aluminium-magnésium et aluminium-zinc-magnésium; Mécanisme des corrosions intergranulaire et sous tension]. Pierre A. Jacquet. Translated from *Rev. met.* 49, 339-63; 439-52(1952). 91p. (AEC-tr-1746)

Al-Mg and Al-Mg-Zn alloys, when exposed simultaneously to a natural or artificial corrosion medium and to tensile mechanical stress, fail prematurely through intergranular cracking. The preparation of the specimens and the methods of study are described in detail. A mechanism of intergranular corrosion and stress corrosion for Al-Mg and Al-Mg-Zn is suggested. It attempts to explain why electrochemical tests of anode attack and coupling in the galvanic cell produces the same qualitative results as the usual stress corrosion experiments. (J.S.R.)

1369

ELECTRIC CONDUCTIVITY OF METALS AT HIGH CURRENT DENSITY. E. S. [Ye. S.] Borovik. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 771-4(1953). 5p. (NSF-tr-140)

The electric conductivity of Bi, Pt, W, and Cu at current densities of $j \sim 10^5$ amp/cm² was measured. For Bi and Pt, constant current and short pulses of current were used; for Cu and W, only the pulse method was used. Platinum was studied at $T = 4^\circ\text{K}$ up to a current density of 1.4×10^5 amp/cm², and Bi was studied at $T = 20.4^\circ\text{K}$ up to a current density of 2.4×10^4 amp/cm². Results show that for Pt, W,

and Cu no deviations from Ohm's law are observed up to current densities of 5 to 8×10^5 amp/cm². For Bi, at the current density 0.5 to 1×10^6 amp/cm², deviations from Ohm's law reaching tens of percent are observed. (J.A.G.)

1370

THE ROLE OF GRAIN BOUNDARIES IN THE PLASTIC DEFORMATION OF ALUMINUM. E. S. Yakovleva and M. V. Yakutovich. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 1027-9(1953). 4p. (NSF-tr-155)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-5777.

1371

HEAT CAPACITY AND RESISTANCE MEASUREMENTS FOR ALUMINUM AND LEAD WIRES. T. E. Pochapsky (Univ. of Chicago). *Acta Met.* 1, 747-51(1953). Nov. (In English)

Heat capacity and electrical resistance measurements are reported for Al and Pb at temperatures ranging from room temperature to near the melting point of each metal. A pulse-heating method is used. The results show that both the heat capacities and temperature coefficients of resistance increase with temperature in such a way as to suggest that they are influenced by a single activated process rather than by impurities. Although this behavior may possibly be explained by a more complete theory of anharmonic lattice vibrations, evidence is presented to suggest a possible relationship between the anomalies and the presence of vacancies. Interpreting the excess heat capacity in terms of the heat of formation of vacancies, however, requires more vacancies than would be expected on the basis of self-diffusion experiments. (auth)

1372

DEFORMATION MECHANISMS IN TITANIUM AT ELATED TEMPERATURES. C. J. McHargue and J. P. Hammond (Univ. of Kentucky, Lexington). *Acta Met.* 1, 700-5(1953). Nov. (In English)

The deformation mechanisms of Ti have been studied for coarse-grained specimens deformed in tension at 815°C. Slip planes of the types $\{10\bar{1}0\}$ and $\{10\bar{1}1\}$ were observed, and it was noted that $\{10\bar{1}1\}$ slip occurs more frequently than at room temperatures. A decrease in the amount of twinning was observed; however, considerable twinning was observed on $\{11\bar{2}1\}$ and $\{11\bar{2}2\}$ planes. No instances of basal slip of $\{10\bar{1}2\}$ twinning were noted at 815°C. (auth)

1373

THE ANNEALING OF COPPER AFTER RADIATION DAMAGE AT LOW TEMPERATURES. R. R. Eggleston (North American Aviation, Inc., Downey, California). *Acta Met.* 1, 679-83(1953). Nov. (In English)

Resistance measurements at the boiling point of liquid He have been made on Cu which was damaged at temperatures below -150°C by an exposure to 35-Mev α particles and then annealed at higher temperatures. The activation energy for the process active at annealing temperatures between -65°C and -20°C is 0.717 ev. At temperatures between 250°C and 325°C the activation energy describing the annealing is 2.12 ev. The activation energy obtained at the lower temperatures is in agreement with the value of 0.672 ev for Cu cold-worked in liquid He, and the value of 0.68 ev obtained by Overhauser on Cu irradiated in a similar manner and annealed in the same low temperature range. Cold-work and radiation damage in Cu were compared qualitatively by making similar constant time anneals at progressively higher temperatures on specimens irradiated at temperatures below -150°C and specimens cold-worked in liquid He. Up to about -80°C the rate of annealing of the two specimens was similar, but at room temperature about 25% of the radiation damage remained compared to 50% remaining in the cold-worked specimen. (auth)

1374

THE INFLUENCE OF OXYGEN CONTENTS ON TRANSFORMATIONS IN A TITANIUM ALLOY CONTAINING 11 PER CENT MOLYBDENUM. D. J. Delazaro and W. Rostoker (Illinois Inst. of Tech., Chicago). *Acta Met.* **1**, 676-8(1953). Nov. (In English)

It has been demonstrated that an approximately quantitative relationship exists between O content and the rate of precipitation of α from β in a Ti + 11% Mo alloy. The presence of O was correlated with the occurrence of sub-grain boundary structures and abnormal variations in precipitation rates from grain to grain. An explanation of the transformation rate effects was suggested in terms of polygonization concepts. (auth)

1375

TERNARY ALLOYS FORMED BY ALUMINIUM, TRANSITIONAL METALS AND DIVALENT METALS. G. V. Raynor, C. R. Faulkner, J. D. Noden, and A. R. Harding (Univ. of Birmingham, England). *Acta Met.* **1**, 629-48 (1953). Nov. (In English)

A general survey has been made, by metallographic and x-ray methods, and by the examination of extracted crystals, of the constitutions of the alloys of Al and Zn with Fe, Co and Ni, of Al and Mg with Co, and of Al and Be with Mn and Fe. In the latter two systems, new ternary compounds $Mn_3Be_2Al_{15}$ and $Fe_3Be_7Al_7$ have been discovered in the equilibrium with the Al-rich solid solution. No ternary compounds in equilibrium with the Al-rich alloys occur in the other systems studied; an unidentified ternary phase separates from Zn-rich alloys in the system Al-Ni-Zn, but does not enter into equilibrium with the Zn rich solid solution. The outstanding feature of the system Al-Co-Zn is the deposition from Zn-rich melts, at low temperatures, of the high-melting phases CoAl and Co_4Al_{13} in addition to Co_2Al_9 ; these phases persist in equilibrium with the Zn-rich alloys, while in the system Al-Co-Mg the high-melting phase CoAl enters into equilibrium with the Mg-rich solid solution. By contrast, only a phase derived from $FeAl_3$, and none of the more Fe-rich Al-Fe compounds, is found in equilibrium with Zn in the system Al-Fe-Zn. The main features of the equilibria are discussed in terms of the free energies of phases present, and the data, taken together with the results of previous work, lead to a better understanding of the factors affecting the formation of Al-rich ternary compounds. (auth)

1376

SOME PLASTIC PROPERTIES OF NICKEL ALLOYS. V. F. Zackay (Pennsylvania State Coll., State College) and T. H. Hazlett (Univ. of California, Berkeley). *Acta Met.* **1**, 624-8(1953). Nov. (In English)

Several physical and chemical properties of the ferromagnetic elements indicate an equivalence of solid-state bonding for Ni and Co. Experimental data on the plastic properties of Ni-base Co alloys substantiate this conclusion. Comparable data on Ni-Fe alloys show that Fe effectively solution-hardens Ni. A sharp discontinuity in the plastic behavior of pure Ni was noted at the Curie temperature. (auth)

1377

A METHOD FOR THE PREPARATION OF URANIUM OXIDE LAYERS ON ALUMINUM. Siegfried Skorka (Physikalisches Staatinstitut, Hamburg, Germany). *Naturwissenschaften* **40**, 605(1953). Dec. (In German)

The Al is rubbed with emery, washed under flowing water, and, without any further chemical pretreatment, submerged in a $UO_2(NO_3)_2$ solution. U_3O_8 precipitates on the Al in a heavy, dull-finished, compact, and strongly adhesive layer. The deposition of U_3O_8 on the Al is discussed as a function of temperature and solution concentration. (J.S.R.)

1378

THE USE OF RADIOACTIVE ISOTOPES IN METALLURGY. R. Shuttleworth (Univ. of Leeds, England) *Brit. J. Appl. Phys.* **4**, 326-9(1953) Nov.

The γ radiation from radioisotopes is used for radiography, and the β radiation for gaging the thickness of foils or, by back-scattering, the thickness of a coating on a base metal. The high sensitivity and ease with which isotopes can be detected and measured provides an easy method of estimating minute amounts of metal that have been labeled by pile irradiation. The most important metallurgical use of isotopes is in the measurement of self-diffusion coefficients, and a technique is described by which the two self-diffusion coefficients of Cu and Zn in brass have been determined simultaneously. A number of methods of estimating activity are briefly described (Geiger, proportional and scintillation counters, and microautoradiography). (auth)

PHYSICS

1379

Los Alamos Scientific Lab.

RAILROAD SWITCHING SHOCK. William H. Cross and Max McWhirter. [1953?] 32p. Contract W-7405-eng-36. (AECU-2783)

Shock measurements made on a railroad freight car and on a shipping container during switching operations are given. Spectra for longitudinal and vertical shocks are presented. A comparison is made between these shocks and spectra and those measured on ramp tests used to simulate railroad switching and coupling. (auth)

1380

Argonne National Lab.

PHYSICS DIVISION QUARTERLY REPORT [FOR] MARCH, APRIL, MAY 1953. August 1953. 116p. Contract W-31-109-eng-38. (ANL-5080)

Progress is reported on the following investigations: a Monte Carlo calculation of the neutron capture efficiency of methyl borate-containing liquid scintillation neutron detectors at incident neutron energies of 10, 173, and 2000 ev; over-all efficiency measurements of liquid counters as a function of neutron energy; total cross section data on Sb, Ga, Ge, Fe, Hg^{200} , and Se; analysis of the 2.58-ev resonance in Gd; installation, operation, and r-f ion source of the Van de Graaff generator; magnetic field-regulating and control system for the proton spectrometer; the 1.42-min isomeric state in Ir^{192} ; decay schemes of Dy^{165m} , Dy^{165} , Gd^{161} , Eu^{152} , Eu^{154} , and V^{48} ; characteristics of a scintillation counter spectrometer; (n,γ) reactions in H_2 ; γ - γ cascade of Hg^{197} ; $Be(\gamma,n)$ angular distributions; transmission neutron cross sections for Ni in the kev region; average charge of daughter atoms after electron capture by A^{87} and isomeric transition of Kr^{83m} ; ratio recording in isotopic analysis by mass spectrographic techniques; natural occurrence of rare isotopes; Mo isotope abundances; heat of vaporization of C ions; energy levels of the states arising from the ground configuration $(1p_{3/2})^m(1p_{1/2})^n$ and the first excited configuration $(1p_{3/2})^{m-1}(1p_{1/2})^{n+1}$ for mass numbers 10 through 15; and improvement and operation of electronic digital computers. (For preceding period see ANL-5031.) (J.S.R.)

1381

DISCONTINUITIES AND SOUND OF LARGE AMPLITUDE

IN HELIUM II. I. M. Khalatnikov. Translated from *Zhur. Eksptl'. i Teoret. Fiz.* 23, 253-64(1952). 12p. Available from the Dept. of Scientific and Industrial Research, London. (CTS-18)

The conditions which must be satisfied at discontinuities in He II are formulated. It is shown that in a superfluid liquid discontinuities of two types are possible—pressure discontinuities and temperature discontinuities. Expressions are derived for determining the rate of discontinuities of low intensity. The problem of propagation of sound of large amplitude in a superfluid liquid is discussed. (auth)

1382

Los Alamos Scientific Lab.

COLLISION KINETICS IN A SHOCK WAVE. T. P. Cotter. Mar. 1952. Decl. Sept. 18, 1952. 17p. Contract W-7405-Eng-36. (LA-1413)

A calculation of the spatial distribution of energetic molecular collisions within a plane shock transition is made, using the Mott-Smith solution of the Boltzmann equation for a shock wave. The results are applied to polytropic gases. If a shock leaves a material with a considerable mass velocity but a moderate temperature, then the transition itself may contain very many high-energy collisions. This condition is shown not to obtain for gases; it may possibly occur in liquids or solids. (auth)

1383

THE NONSTEADY RATE OF NUCLEATION OF A NEW PHASE UNDER GREAT SUPERCOOLING. B. Ya. Lyubov. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 245-8 (1953). 4p. (NSF-tr-109)

During the cooling of a single-component system which can exist in various phase states, the high-temperature states must, from the purely thermodynamic viewpoint, completely disappear below the equilibrium temperature of the phases. However, experimental evidence shows that the high-temperature phase may exist in a metastable state for a long time at low temperatures. A statistical analysis, which takes into account the possibility of thermodynamically unfavorable changes in the system, shows how the high-temperature metastable state exists at low temperatures. The analysis is correct as long as factors such as collision of nuclei and decrease in the volume of the old phase in the course of the transformation are ignored. (J.S.R.)

1384

ON THE EFFECT OF CHANGE IN DEFORMATION RATE ON PLASTIC DEFORMATION. L. I. Vasilev [Vasilyev], A. S. Bylina, and M. P. Zagrebennikova. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 767-9(1953). 3p. (NSF-tr-138)

The experimental data indicate that the rate of the preceding plastic deformation has a considerable effect on the further deformation and show convincingly that the current value of the stress in the general case is not a single-valued function of the instantaneous values of deformation, of the deformation rate, and of the temperature of the experiment. Thus, the mechanical equation of state $\sigma = f(\epsilon, \nu, T)$ is limited and approximate. (auth)

1385

CHARACTERISTIC FUNCTIONS OF REAL RESONATORS. V. M. Vakhnin. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 779-82(1953). 4p. (NSF-tr-166)

Solutions for the oscillations of a finite linear system are reviewed for the case of an ideal harmonic resonator, and the method of expansion to characteristic functions is extended to methods for solving the case of a real resonator with losses on the boundaries. A system of characteristic functions is constructed which satisfies the condition of orthogonality in real resonators, in addition to the dissipa-

tive boundary conditions. The method is applied to a piecewise-nonhomogeneous, one-dimensional system consisting of an infinite two-wire transmission line with energy losses caused by parallel distributed conductivity. (K.S.)

1386

THE VIBRATION FREQUENCY OF AN EXISTING MOLECULE OF THE TYPE XX IN THE GROUND STATE. Yatendra Pal Varshni (Univ. of Allahabad, India). *Z. Physik* 135, 512-15(1953). (In German)

A correction for the Matuyama-Clark relation of the vibration frequency of a two-atom molecule of the type XX in the ground state was given. This relation for the numerical value is: $\log \omega_e = g - h \log n^2 V$, where n is the principal quantum number of the valence electron, V is the ionization potential, and g and h are constants. The ionization potentials of Po(9.44 ev), At(10.4 ev), and Fr(3.83 ev) were calculated. (tr-auth)

COSMIC RADIATION

1387

THE ELECTRON COMPONENT AND THE ORIGIN OF COSMIC RAYS. V. L. Ginzburg and M. I. Fradkin. Translated from *Doklady Akad. Nauk S.S.S.R.* 92, 531-4 (1953). 5p. (NSF-tr-159)

The various theories of the source of cosmic rays are analyzed, and it is decided that the most probable origin is supernovae. The novae emit radiowaves, which, in stellar magnetic fields, produce bremsstrahlung electrons and hence cosmic rays. (J.S.R.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1388

PLASTICITY AND MOSAIC STRUCTURE OF CRYSTALS. Albert Kochendörfer. Translated by Margaret V. Colven from *Z. Metallkunde* 30, 299-305(1938). 20p. (AEC-tr-1754)

The atomic process of slip was studied. The mean distance L of the plastically active misplacement was calculated from the energy relationship for recrystallized Al crystals to be 8.5×10^{-6} cm. The plastic properties were changed with the misplacement distance L . If L is sufficiently small, no plastic deformation is possible below the "knee value" of the critical shearing stress; for large L , on the other hand, plastic deformation begins with even small shearing stress. In the region of abundant slip the critical shearing stress and course of the hardening curve depend only slightly on L . As the bases of these theoretical and concordant experimental results the idea is established that the plastically active misplacements are found in the mosaic boundary surface. (auth)

1389

VALENCE STABILIZATION IN CRYSTALS. Dieter M. Gruen. (Argonne National Lab., Lemont, Illinois). *J. Chem. Phys.* 21, 2083(1953). Nov.

A model is proposed for the effect of valence inductivity. If the multiple valency cation M with charge of 1 is in a solid solution with an excess of fixed valency anions, the cation will be ionized from M^+ to M^{++} by a mechanism of double exchange. The vacant lattice sites will be filled by the excess anions. Or if the cation M is replaced by the single valency A^+ , the $M^+ \rightarrow M^{++} + e$ reaction will occur. As M^+ is isolated by being surrounded by excess anions or A^+ , it will not ionize and its valency will be stabilized. Phase effects have been observed in Pr oxide, La_2O_3 - Pr_2O_3 , and UO_2 - ThO_2 systems. (J.S.R.)

1390

ELECTRONIC ENERGY BANDS IN CRYSTALS. Thomas Wainwright and George Parzen. (Univ. of Notre Dame, Notre Dame, Indiana). *Phys. Rev.* 92, 1129-34(1953). Dec. 1.

In a previous paper (G. Parzen, *Phys. Rev.* **89**, 237(1953)) a variational principle was derived for the energy levels of a crystal. The variational principle was stated in terms of the Wannier functions of the crystal instead of the more usual Bloch waves. In this paper, the variational principle has been applied to two problems, namely, to the one-dimensional cosine potential and to the energy levels of the valence band of Li. The method of forming the trial function is discussed. It was found more convenient to use the Wannier function in momentum space rather than in configuration space. In the Li case, the results are compared with those obtained by the Wigner-Seitz spherical approximation. (auth)

ELECTRONS

1391

EFFECT OF THE SURFACE ON THE MAGNETIC PROPERTIES OF AN ELECTRON GAS. Frank S. Ham. (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **92**, 1113-19(1953). Dec. 1.

The energy levels of free electrons confined to a finite cylindrical box with a uniform axial magnetic field are obtained by the WKB approximation and used to compute the magnetic susceptibility with Fermi statistics. The usual treatments which neglect the effects of the walls are shown to be justified for both the steady susceptibility and the de Haas-van Alphen terms, provided the radius of the box is sufficiently large. In the case of the oscillatory terms it is only necessary that the radius of the box exceed the classical orbit radius R_c of an electron having the Fermi energy ζ in the magnetic field. However, there exists a surface correction to the steady susceptibility whose magnitude relative to the Landau value is $(\zeta/\beta H)^{1/2}(R_c/R)$. This surface correction, the existence of which has been previously pointed out by Osborne and Steele, and by Dingle, is shown to be extremely sensitive to the exact boundary conditions at the surface, including both the abruptness of the surface jump in potential and the height of the barrier relative to the Fermi energy. Indeed, the correction term can be either paramagnetic or diamagnetic depending on these details. The form of the WKB approximation appropriate to different boundary conditions is discussed, and a modification of Dingle's theory is presented which may be used to calculate approximately the susceptibility of the system for any value of the ratio R/R_c when the boundary conditions are known. (auth)

1392

ENERGY LOSS OF MOVING ELECTRONS TO DIPOLAR RELAXATION. H. Fröhlich and R. L. Platzman. (Purdue Univ., Lafayette, Indiana). *Phys. Rev.* **92**, 1152-4(1953). Dec. 1.

The relation between energy loss of a moving charged particle and dielectric loss in an insulator is analyzed, and a formula giving the rate of energy loss to dielectric relaxation of an electron traversing a dipolar medium is deduced. For an electron having kinetic energy lower than the lowest electronic excitation potential, this interaction makes a substantial contribution to the total energy loss, one often comparable to the loss to molecular or lattice oscillations. Possible applications in physics and in radiobiology are mentioned. (auth)

1393

STUDIES ON THE RADIATION FROM ELECTRONS IN CIRCULAR ACCELERATORS. Haakon Olsen. *Kgl. Norske Videnskab. Selskabs, Skrifter* (1952) No. 5. (64p.)

The emission of light from electrons moving in external magnetic fields, such as a betatron or synchrotron, is theoretically presented in detail. Equations are developed

from a classical and quantum approach, and it is found that the classical electrodynamical calculations of Schwinger are confirmed. (K.S.)

1394

IS THERE AN EXCITED STATE IN ELEMENTARY PARTICLES? (BILOCAL QUANTUM THEORY OF ELECTRONS). Erich Bagge (Physikalisches Staatsinstitut, Hamburg, Germany). *Z. Physik* **135**, 558-72(1953). (In German)

An attempt was made to describe the inner reciprocal action in elementary particles with the help of a bilocal wave function with retention of the statistical interpretation of the quantum mechanic wave function. The extension of the bilocal theory to an electron raises an eigenvalue problem for the possible stationary states of this particle, which states can have a different individual angular momentum. For electromagnetic reciprocal actions of the Coulomb-Darwin sort (with its divergent behavior at small energies), the energy for the inner reciprocal action assumes infinite values. The theory, furthermore, makes the statement that there is, because of their structure, a total fixed rest mass of the electrons which is not explainable by electromagnetism. The characteristic mass was determined as the ground mass, and from that the energy value of the higher excited state of the electron was calculated. (tr-auth)

1395

METHOD OF MEASURING THE CHARGE OF SWIFTLY MOVING ELECTRONS. R. Fleischmann and R. Kollath (Physikalisches Staatsinstitut, Hamburg, Germany). *Z. Physik* **135**, 526-9(1953). (In German)

A method of measuring the charge of swiftly moving electrons is suggested. It can be verified experimentally that the change of m/e results from the change of m arising from excessive velocity. (tr-auth)

1396

MOVEMENT OF AN ELECTRON IN A MAGNETIC WAVE. René Combe and Marc Feix. *Compt. rend.* **237**, 1318-20 (1953) Nov. 23. (In French)

Equations are rigorously solved for the movement of an electron in a magnetic wave. The arrangement produces a constant magnetic field and some sinusoidal distribution in space. The utilization of the movement of an electron in a magnetic wave for the production of short electromagnetic waves was considered. (tr-auth)

GASES

1397

Knolls Atomic Power Lab.

THE THIRD VIRIAL COEFFICIENT OF A LENNARD-JONES GAS BY KIHARA'S METHOD, WITH TABLES FOR THE 6-9 POTENTIAL. Leo F. Epstein, Celesta J. Hibbert, Marion D. Powers, and Glenn M. Roe. [1952?] 52p. Contract W-31-109 Eng-52. (AECU-2731)

Kihara has shown that the third virial coefficient of a Lennard-Jones 6-9 gas can be expressed as a convergent power series of the form $\sum_j \beta_j(s) \theta^{(s-j)/9}$ with $\theta = \epsilon/kT$. In this paper the coefficients $\beta_j(s)$, which are rather complicated double integrals, are developed and applied to the case $s = 9$. For $j < 20$ the coefficients are obtained by numerical quadrature, using high-speed computing equipment. Asymptotic formulas for arbitrary s are developed and used to extrapolate the numerical results for $s = 9$ into the range $20 < j < 100$. Values of the normalized third virial coefficient, $C_3^0(\theta)$, and its derivatives, computed from Kihara's series, are tabulated for the range $0 < \theta < 2$. An asymptotic expression for $C_3^0(\theta)$ is developed and used to extend the tables to higher values of θ . (auth)

*1398

Hanford Works

EXPERIMENTAL THERMAL CONDUCTIVITIES OF GASES AND GASEOUS MIXTURES AT ZERO DEGREES CENTI- GRADE. J. M. Davidson and J. F. Music. July 3, 1953. 30p. Contract W-31-109-eng-52. (HW-29021)

The thermal conductivities of CO_2 , He, Ne, N_2 and their binary mixtures at 0°C are presented. The results are in agreement with known calculated and experimental data. Empirical equations expressing the thermal conductivity at different mole fractions of the components are given where applicable. The method used is described. (auth)

*1399

Radiation Lab., Univ. of Calif., Berkeley

THERMAL CONDUCTIVITY OF GASES AT HIGH TEM- PERATURES (thesis). Albert Joel Rothman. Jan. 1954. 115p. Contract W-7405-eng-48. (UCRL-2339)

An apparatus suitable for measuring thermal conduc- tivities of gases from 30 to 800°C was designed and operated successfully. The apparatus consists primarily of a con- ductivity cell formed of a pair of concentric Ag cylinders, a constant-temperature furnace, and suitable control and measuring equipment. Conductivity values were obtained for N_2 , CO_2 , and mixtures of the two at 5 or 6 temperatures from 50 to 775°C . In addition, conductivities of A were measured from 50 to 680°C , and those of air and He at 40 and 680°C , respectively. The results lie in the range of most investigators' values at all temperatures. Experi- mental uncertainty is about 1%, except for data at the two highest temperatures, 680 and 775°C , which are estimated to be 2.5 and 3% high, respectively. These errors were caused by the formation of gas bubbles on the Ag surfaces above 600°C which reduced the annular spacing between the cylinders. The largest radiation correction required was 8%. Approximate accommodation coefficients were obtained for air, N_2 , CO_2 , A, and He on Ag. (auth)

INSTRUMENTS

1400

Columbia Radiation Lab., Columbia Univ.

QUARTERLY PROGRESS REPORT NO. 3 [FOR JULY- AUGUST 1953]. Aug. 31, 1953. 29p. Contract DA-36- 039-sc-42519. (CU-3-53-SC-42519-Phys.)

The operating characteristics of various types of magnetrons are discussed. An experiment whereby Cherenkov radiation was observed at K-band frequencies is described. The maximum power output of a 2K33 klystron under pulsed conditions was measured as 4.3 w. The modification of equipment for hfs studies is discussed. Results of measurements of the nuclear quadrupole resonant frequencies of Sb^{121} and Sb^{123} at melting-ice temperature are presented. Microwave spectral lines of NaBr, LiF, and LiBr were observed with the aid of a new absorption cell. The microwave spectrum of deuterated fluorosilane was investigated. Frequencies of the observed lines in the OD microwave spectrum are presented. Microwave spectral measurements on RbCl by the molecular beam electric resonance method are discussed. Frequencies of two lines of the $J = 0 \rightarrow 1$ transition of Dl^{127} were measured to a greater accuracy. (For preceding period see CU-2-53-SC-42519- Phys.) (L.M.T.)

*1401

North American Aviation, Inc.

A REVERSING LOGARITHMIC DC AMPLIFIER. R. L. Carter. Issued Jan. 1, 1954. 12p. Contract AT-11-1- GEN-8. (NAA-SR-120)

In the course of devising automatic recording instrumen- tation for a high-temperature Sykes experiment it was necessary to design and build a nonlinear differential

amplifier. The experiment required the reading of differ- ential voltages which were changing too rapidly for manual operation of a precision potentiometer. At the same time, the precision required in the determination of small differ- ential voltages did not allow on-scale readings for larger values of differential voltages with any known commercially available recording millivoltmeter or potentiometer. A high-sensitivity, nonlinear, high-impedance d-c amplifier to permit the application of a continuously recording in- strument was designed. (auth)

1402

APPLICATION OF DIGITAL COMPUTING TECHNIQUES TO PHYSICS. R. A. Brooker (Univ. of Manchester, England) Brit. J. Appl. Phys. 4, 321-6(1953) Nov.

Some computations likely to occur in connection with physical problems are discussed in relation to electronic computers. General discussion is reinforced by examples taken from the literature, for which figures about programming time, machine running time, etc., are given. Some aspects of machine design are discussed. The article concludes with a note on the training of personnel in the use of electronic computers. (auth)

ISOTOPE SEPARATION

1403

ISOTOPE SEPARATION WITH A CONTINUOUSLY OPER- ATING SEPARATION TUBE. Erwin David (Physikalisches Staatsinstitut, Hamburg, Germany). Z. Physik 134, 377-96 (1953).

The Clusius-Dickel separation tube process is the sim- plest method of isotope separation for material which can be converted to an applicable gaseous form. A continuously operating arrangement is suggested by which the most con- venient radius is given to the tube by a continuous, fine- control radius variation. (tr-auth)

MATHEMATICS

*1404

Argonne National Lab.

PROCEEDINGS OF A SYMPOSIUM ON LARGE SCALE DIGITAL COMPUTING MACHINERY, AUGUST 3-5, 1953. 317p. (ANL-5181)

This volume of the Proceedings is a collection of the transcripts of papers presented at the Computer Symposium sponsored by Argonne National Lab. on Aug. 3, 4, and 5, 1953. These papers deal mainly with the engineering aspects of the design of digital computers. The problems en- countered in the employment of cathode-ray tubes as storage devices and the advances in circuit techniques are discussed in six papers on Williams tube memory. Theory of operation and the practical application of large-scale ferromagnetic memory are presented in the four papers on this subject. A survey of the work done at Bell Labs. in connection with the application of transistors to high- speed computers is covered in the papers presented by the staff of the Bell Labs. Other topics of current interest, such as magnetic recording, ferroelectrics, programming experience, experimental mathematics, as well as weather computations, are discussed. (auth)

1405

THE CONNECTION BETWEEN THE R-MATRIX AND THE S-MATRIX. N. G. van Kampen (Inst. for Advanced Study, Princeton, New Jersey). Rev. mexicana fis. 2, 233-43 (1953) Oct. (In English)

It is shown that the analytic properties that Wigner found for the R-matrix are equivalent to the properties of the S-matrix which are deduced from the causality con- dition. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

1406

Institute of Industrial Research, Syracuse Univ.
NON-ELECTRONIC DOSE RATE INDICATING SYSTEMS.
QUARTERLY PROGRESS REPORT NO. 6 [FOR] SEPTEMBER 15, 1953–DECEMBER 15, 1953. Herbert Rubin. 23p. Contract DA-36-039-sc-15533. (NP-5013)

The solvent system 1:1 carbon tetrachloride-pyridine has been selected as a medium for the study of the radiolysis of Fe salts. These salts, tetrapyridino-ferrous chloride and ferric chloride, have absorption peaks in the near ultraviolet and follow Beer's law in pyridine. Their solutions in the solvent mixture have been irradiated at total doses of 2×10^2 , 2×10^3 , and 2×10^4 roentgens. The results of the radiations are discussed. (For preceding period see NP-4928.) (C.H.)

1407

Scientific Specialties Corp.
PHOTOVOLTAIC DOSE RATE INDICATOR. QUARTERLY PROGRESS REPORT NO. 2 COVERING THE PERIOD SEPTEMBER 1, 1953 THROUGH NOVEMBER 30, 1953. Richard G. Seed and Edith C. Parnell. 40p. Contract DA-36-039-sc-42727. (NP-5014)

Progress is reported in the collection of empirical information and assemblage and construction of devices for test purposes. Data are presented from studies of the sensitivity of ordinary Se on Fe photovoltaic cells to x and γ rays tested over an extensive range of energies and radiation intensities. (For preceding period see NP-4933.) (C.H.)

*1408

Atomic Energy Project, Univ. of Rochester
COMPARISON OF THE PHOTOGRAPHIC EFFECTS PRODUCED BY CADMIUM AND RHODIUM AFTER NEUTRON BOMBARDMENT WITH REFERENCE TO PERSONNEL MONITORING. Gerald J. Rausa. Oct. 7, 1953. 29p. Contract W-7401-eng-49. (UR-253)

An attempt is made to recalibrate the neutron film badge, as described by Dessauer, in terms of neutrons per cm^2 per sec, rather than "n" units, and to increase the sensitivity of the method by the use of Rh in place of Cd. Curves presented show the response of the film badges exposed to Po-Be neutrons, both fast and moderated. The results indicate that neither method is sufficiently sensitive for measurement of tolerance doses of fast neutrons, but that the badges containing Cd could be used for thermal neutron monitoring since Rh badge is too sensitive. (auth)

1409

MECHANISM OF IMPURITY POISONING IN THE LUMINESCENCE OF ZINC SULFIDE PHOSPHORS WITH MANGANESE ACTIVATOR. Richard H. Bube, Simon Larach, and Ross E. Shrader. (Radio Corp. of America, Princeton, New Jersey). *Phys. Rev.* **92**, 1135-9(1953). Dec. 1.

An investigation was made of the poisoning effects of Fe, Co, and Ni impurity in cub.-ZnS:Mn phosphors. The parameters varied included: (1) proportion of Mn, (2) proportion of poison impurity, (3) photon energy of the exciting radiation, (4) intensity of the exciting radiation, and (5) operating temperature of the phosphor. Analysis of the results shows that the two most important poisoning mechanisms are: (1) dissipation by poison centers of energy absorbed by the host crystal before this energy has been used to excite activator centers, a mechanism relatively independent of the proportion of Mn and type of poison, and (2) dissipative interaction between activator and poison centers, a mechanism which depends strongly on the proportion of Mn and type of poison. The first mechanism predominates when the primary excitation is absorbed by the host crystal, whereas the second predominates when the activator centers are excited directly. (auth)

1410

GEIGER COUNTERS. R. Richard Foy (Instituto Nacional de la Investigación Científica, Mexico). *Rev. mexicana fis.* **2**, 215-21(1953). Oct. (In Spanish)

A Geiger counter has been constructed in which the cathode is formed by vaporization of part of the filament. The instrument has great stability after degasification is complete. The counters are very photosensitive to wave lengths below blue. The effects of temperature and of a resistance and a condenser in parallel between the counter and the ground have been studied. (tr-auth)

1411

THE LIGHT SENSITIVITY OF A SELF-QUENCHING GLASS GEIGER TUBE WITH EXTERNAL CATHODE. Helmut Schwarz (Univ. do Brasil, Rio de Janeiro, Brazil). *Z. Physik* **134**, 540-5(1953). (In German)

Several experiments were carried out in order to find an explanation for the light sensitivity of the self-quenching glass Geiger tube with external cathode. The effect appears as false tube impulses or double impulses in daylight. One could distinguish between photoelectric effects on the inner glass surface (surface effect) and in the gas volume (volume effect). The volume effect appears in connection with electron addition to the O molecule, which originates either in the tube still at rest or during the decomposition of the alcohol vapor in the operation of the tube. When the O, through light absorption, is in a metastable state, the probability of electron addition increases. The surface effect appears to originate with the decrease of the stopping energy of the glass by adsorption of H_2 , for example, on a compound which originates from the decomposition of the alcohol vapor. (tr-auth)

1412

ON AN APPARATUS FOR REGISTERING PARTICLES EMITTED BY THE RADIOELEMENTS: CINENUCLEOGRAPH. Marcel Frilley. *Compt. rend.* **237**, 1326-7(1953) Nov. 23. (In French)

An apparatus was constructed which permitted the registration, on a photographic plate with a thick emulsion, of the trajectories of ionizing particles emitted by a source moving rapidly in a plane parallel to that of the plate. The apparatus is described in detail. (J.S.R.)

MESONS

1413

THE INTERACTION OF π MESONS WITH ATOMIC NUCLEI. Norman C. Francis and Kenneth M. Watson (Univ. of Indiana, Bloomington). *Am. J. Phys.* **21**, 659-72(1953). Dec.

The interactions of π mesons with nuclei are reviewed and interpreted in terms of the Serber model of nuclear reactions at high energies. This involves introducing the concept of a mean free path for both meson scattering and absorption in nuclear matter. These quantities are discussed in relation to the relevant experimental data. A discussion of the "optical model" of nuclear scattering is also included. (auth)

1414

LEVEL CALCULATIONS IN μ -MESIC ATOMS. S. W. Flügge and F. T. Adler (Carnegie Inst. of Tech., Pittsburgh). *Naturwissenschaften* **40**, 601-2(1953). Dec. (In English)

Simple expressions for binding energies in μ -mesic atoms were obtained by straightforward perturbation calculations. The level splitting due to the spin of the μ meson and a possible anomalous magnetic moment were calculated, assuming that the meson has spin $\frac{1}{2}$ and that it can be described by a two-component approximation from the Dirac equation containing the Pauli term. (J.S.R.)

MOLECULAR PROPERTIES

1415

Naval Research Lab., Univ. of Wisconsin

THE INTERMOLECULAR POTENTIALS FOR SOME SIMPLE NON-POLAR MOLECULES. Edward A. Mason and William E. Rice. Nov. 6, 1953. 35p. Contract N70nr-28511. (WIS-ONR-6)

Experimental data on the crystal properties, second virial coefficients, and viscosity coefficients of Ne, A, Kr, Xe, CH₄, N₂, CO, O₂, and CO₂ were analyzed for the purpose of obtaining values of the parameters in the intermolecular potential,

$$\varphi(r) = \frac{\epsilon}{1 - 6/\alpha} \left[\frac{6}{\alpha} e^{\alpha(1 - r/r_m)} - \left(\frac{r_m}{r} \right)^6 \right].$$

For gases whose molecules are spherical, it was possible to reproduce, with a single set of potential parameters, not only the crystal, second virial, and viscosity data but also data on other transport properties with fair accuracy. For gases whose molecules deviate appreciably from spherical symmetry it was necessary to choose at least two different sets of potential parameters in order to reproduce different types of properties. Such behavior was taken to indicate the inadequacy of the assumptions, made in the fundamental gas theories, that intermolecular forces are central and that intermolecular collisions are elastic. (auth)

1416

STRUCTURE OF LIQUID NITROGEN, OXYGEN, AND ARGON BY NEUTRON DIFFRACTION. D. G. Henshaw, D. G. Hurst, and N. K. Pope. (Atomic Energy of Canada, Ltd., Chalk River, Ontario). *Phys. Rev.* **92**, 1229-34(1953) Dec. 1.

The structures of liquid O, N, and A have been investigated by measuring the scattering of neutrons of wavelength 1.08Å over the angular range 4 to 78°. The scattering curves have been transformed to give the time average of the atomic density as a function of the distance from an atom taken as center. The deviation from the mean density is an oscillating function with an amplitude which decreases more rapidly than the inverse square of the distance from the central atom. In N a single neighbor is found at a spacing of 1.1Å from each atom, corresponding to a diatomic molecule in the liquid. In O 1.5 neighbors are found at approximately 1.25Å from each atom, suggesting that the degree of association is greater than diatomic. The results are not inconsistent with the suggested existence of the O₄ molecule. In A the results are in reasonable agreement with published x-ray determinations. (auth)

NUCLEAR PHYSICS

1417

Los Alamos Scientific Lab.

INTERPRETATIONS OF THE VELOCITY DISTRIBUTIONS OF SLOWED FISSION FRAGMENTS. H. W. Schmitt and R. B. Leachman. [1953] Dec. 17, 1953. 15p. Contract W-7405-eng-36. (AECD-3605)

The velocity distributions of slowed U²³⁵ fission fragments were measured. Fine structure appears in the slowed-fragment but not in the unslowed-fragment distributions. Three possible interpretations are considered, one of which is invalid and two of which indicate only small effects. A fourth and most plausible explanation is based on an analysis of the velocity loss of fission fragments which leads to a change in the contour presentations of slowed-fragment data relative to those of unslowed-fragment data. (J.S.R.)

1418

PAIR ANNIHILATION IN A HOMOGENEOUS MAGNETIC FIELD. E. Kroupa and H. Robl (Univ. Wien, Vienna,

Austria). *Acta Phys. Austriaca* **8**, 35-41(1953). (In German)

The influence of a homogeneous magnetic field on the annihilation of an electron-positron pair with emission of two light quanta was investigated. In the absence of a field, the light quanta in the center of gravity of the electron-positron pair system were emitted with equally high energies in opposite directions. A weak energy and angular scattering of the light quanta were caused by a magnetic field parallel to the motion direction of the electron and positron. (tr-auth)

NUCLEAR PROPERTIES

1419

Radiation Lab., Univ. of Calif., Berkeley

NEON 18. J. D. Gow and Luis W. Alvarez. Oct. 22, 1953. 12p. Contract W-7405-eng-48. (UCRL-2379)

A new radioactivity which was assigned to the nucleus Ne¹⁸ has been investigated. The decay is by the emission of positrons with an upper limit of 3.2 ± 0.2 Mev and a half life of 1.6 sec. The spectrum of β rays was compared directly in a magnetic spectrograph with the known radiation of He⁶. The β-ray energy and decay rate correspond to a log ft value of 2.9 ± 0.2, placing the activity in the superallowed class. (auth)

1420

THE RELATIVE EFFECTIVE CROSS-SECTIONS FOR THE (γ,n) PROCESS WITH LITHIUM-GAMMA RADIATION (QUANTUM ENERGY hv = 17.5 MeV). H. Wäffler and O. Hirzel. Translated from *Helv. Phys. Acta* **21**, 200-3 (1948). 5p. (AERE-Trans-11/3/5/386)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 1-1483.

1421

NUCLEAR SURFACE OSCILLATIONS. A. K. Kerman. (Mass. Inst. of Tech., Cambridge). *Phys. Rev.* **92**, 1176-83(1953). Dec. 1.

The extreme shell model of the nucleus is extended by allowing the last odd nucleon to interact with collective modes of motion of the even-even nuclear core. The interaction between a nucleon and the surface oscillations of the core was given by Bohr and is employed here with a Fock space representation for the core excitation. Because of the interaction neither the nucleon nor the core conserve their angular momentum, but the total angular momentum is conserved. The problem is treated by the Tamm-Dancoff method. In terms of the Tamm-Dancoff wave function, formulas are derived for the magnetic moment and the quadrupole moment of an odd nucleus. The energy of excitation of the core is taken empirically from the first excited state of the corresponding even-even nucleus. With this procedure all the parameters of the theory are fixed. The magnetic moment deviations calculated in this manner agree with experiment for nuclei in which the total angular momentum is one half, but the agreement does not exist for higher angular momenta. It is also possible to obtain a qualitative fit for the large quadrupole moments of nuclei with odd numbers of nucleons between 50 and 82. The problem of two equivalent nucleons outside a closed shell is treated in the same manner, and it is shown that the first and second excited states have spins 2 and 4 as usually observed. In addition there is a pairing-energy binding effect in the ground state which is larger when the individual angular momenta of the two nucleons is larger. This is the pairing-energy rule usually employed in shell model calculations. (auth)

1422

THE NUCLEAR SPIN AND QUADRUPOLE MOMENT OF I¹³¹. Ralph Livingston and Ben M. Benjamin (Oak Ridge

National Lab., Tenn.) and J. T. Cox and Walter Gordy (Duke Univ., Durham, N. C.). *Phys. Rev.* **92**, 1271-2(1953). Dec. 1.

Measurements on the $J = 2 \rightarrow 3$ rotational transition of $\text{CH}_3^{131}\text{I}$ have been made in the 6.75-mm wavelength region. The nuclear spin of I^{131} was found to be $7/2$, and the quadrupole coupling, -973 ± 9 Mc/sec. This coupling gives $-0.412 \times 10^{-24} \text{ cm}^2$ for the quadrupole moment of I^{131} . (auth)

1423

THE SPIN OF Si^{28} AND MASS RATIOS OF THE STABLE Si ISOTOPES. R. L. White and C. H. Townes. (Columbia Univ., New York). *Phys. Rev.* **92**, 1256-7(1953) Dec. 1.

The $J = 0 \rightarrow 1$ microwave transition of $\text{Si}^{28}\text{D}_3\text{F}$ has been examined under high resolution for hfs due to Si^{28} . No hfs was found, which sets an upper limit of $1 \times 10^{-28} \text{ cm}^2$ to the quadrupole moment of Si^{28} . This is good evidence that the Si^{28} spin is $1/2$. The measurement also allows an accurate determination of mass difference ratios for the Si isotopes. (auth)

1424

THE SPIN AND MAGNETIC MOMENT OF Ti^{47} AND Ti^{48} AND THE MAGNETIC MOMENT OF Ge^{73} . C. D. Jeffries. (Univ. of Calif., Berkeley). *Phys. Rev.* **92**, 1262-3(1953) Dec. 1.

The spin and magnetic moment of Ti^{47} and Ti^{48} have been measured by nuclear induction. The results are: $I(\text{Ti}^{47}) = 5/2$, $I(\text{Ti}^{48}) = 1/2$, $\mu(\text{Ti}^{47}) = -(0.78706 \pm 0.0001) \text{ nm}$, $\mu(\text{Ti}^{48}) = -(1.1022 \pm 0.0002) \text{ nm}$. The magnetic moment of Ge^{73} has been measured by nuclear induction with the results: $\mu(\text{Ge}^{73}) = -(0.87675 \pm 0.00012) \text{ nm}$. These results are compared to the predictions of the shell model of nuclear structure. (auth)

1425

NUCLEAR QUADRUPOLE RESONANCE OF THE STABLE GALLIUM ISOTOPES. H. G. Dehmelt. (Duke Univ., Durham, N. C.). *Phys. Rev.* **92**, 1240(1953) Dec. 1.

Eight absorption lines have been observed in a sample of polycrystalline GaCl_3 . Of these, six are ascribed to the Cl isotopes. The remaining two, which are due to the stable isotopes $\text{Ga}^{69,71}$, allow the determination of the ratio of their quadrupole moments. $Q_{\text{Ga}^{69}}/Q_{\text{Ga}^{71}} = 1.5867 \pm 0.0004$, in agreement with earlier atomic-beam measurements. (auth)

1426

THE 0^+ STATE OF THE $(4n+2)$ NUCLEUS. P. Stähelin. *Helv. Phys. Acta* **26**, 691-6(1953). (In German)

Deep-lying excited states are known in Li^6 , B^{10} , and N^{14} . The even parity for the zero spin is shown, and to it the isotopic spin $T = 1$ is ascribed, which corresponds to the diversity of the coulomb energy for the ground states of their adjacent isobars. Nuclear states with the same properties were found also in Al^{26} , Cl^{34} , and K^{38} . The charge independence of the nuclear force was thus confirmed. The spin of the ground state can thus be determined from the even-odd proton and neutron number. The energy and spin of some nuclei are tabulated. (J.S.R.)

NUCLEAR TRANSFORMATION

1427

THE RADIONUCLIDES OF ARSENIC PRODUCED BY DEUTERON BOMBARDMENT OF GERMANIUM. H. J. Watters and J. F. Fagan, Jr. (Mass. Inst. of Tech., Cambridge). *Phys. Rev.* **92**, 1248-9(1953) Dec. 1.

The As produced by a deuteron bombardment of Ge has been studied to determine the nuclides present in the mixture. Identification of the isotopes was made by comparing measured values of half life and maximum β energy with published values. Counting rates were measured with 4π and coincidence counters. The half lives obtained indicated that the nuclidic mixture was made up of As^{71} , As^{72} ,

As^{73} , As^{74} , and As^{77} . These findings were confirmed by maximum β -energy values obtained by absorption measurements and by γ -energy values found by means of a γ -ray scintillation spectrometer. Measurements indicated that the 40-hr half life reported for As^{77} is in error by a significant amount and that no As^{76} was obtained from this bombardment. Thick-target yield data were determined for each nuclide from the 4π counter measurements. (auth)

RADIATION ABSORPTION AND SCATTERING

1428

Nuclear Development Associates, Inc. FAST NEUTRON DATA FOR OXYGEN. Herbert Goldstein. Nov. 3, 1953. 24p. Contract AT(30-1)-862. (NDA-Memo-15C-15)

A detailed survey has been made of current values of fast neutron total cross sections, scattering cross sections, and elastically scattered angular distributions in oxygen. The data are collected in convenient form for energies up to 18 Mev, with separate discussions outlining each cross section determination. (K.S.)

*1429

Radiation Lab., Univ. of Calif., Berkeley ELASTIC AND INELASTIC SCATTERING OF 90-MEV NEUTRONS BY DEUTERONS (thesis). Byron L. Youtz. Aug. 13, 1953. 64p. Contract W-7405-eng-48. (UCRL-2307)

The differential cross sections were measured for the elastic scattering and for the n-p type of inelastic scattering of 90-Mev neutrons by deuterons. The neutrons, produced in the stripping of 190-Mev deuterons by a Be target in the Berkeley 184-in. synchrocyclotron, have an energy distribution centered at 90 Mev with a spread of 30 Mev full width at the half-maximum. Normalization of the cross sections was made by comparison to the n-p scattering cross sections of Hadley et al. The angular range between 5 and 40° in the laboratory system was covered for both the elastic and inelastic reactions with 2.5° angular resolution. The experimental data are compared to the theory of Chew, which uses the impulse approximation with central forces only, and to the theory of Horie, Tamura, and Yoshida, which is based on the Born approximation but includes both central and tensor forces. Furthermore, the data for elastic scattering are shown to be in satisfactory agreement, over the angular range covered, with the results of Stern for 190-Mev d-p scattering, thus lending further support to the idea of charge independence of nuclear forces at moderately high energies. (auth)

1430

DIFFERENTIAL AND TOTAL EFFECTIVE CROSS SECTION OF THE INELASTIC SCATTERING IN THE CONTINUUM THEORY. Otto Hittmair (Institut Poincaré, Paris, France). *Z. Physik* **134**, 483-7(1953). (In German)

A general expression for the differential and total effective cross section of a $(a, \bar{a}; \gamma)$ reaction is indicated on the basis of the statistical hypothesis of the continuum theory. Some results of previous work are improved. The inelastic neutron scattering of Cd^{111} is treated numerically. (tr-auth)

1431

MULTILEVEL SCATTERING IN FOCK SPACE. II. F. M. Medina N. (Univ. Nacional Autonoma, Mexico). *Rev. mexicana fis.* **2**, 268-304(1953) Oct. (In Spanish)

In a previous note under the same title (*Rev. mexicana fis.* **2**, 117(1953)) a description of many-level scattering in Fock space was given. In this paper the time dependent solution for the scattering and disintegration processes is discussed. The asymptotic behavior of these time-dependent solutions and the transient effects in the scattered current are analyzed. (auth)

1432

INTERACTION OF 19-MEV DEUTERONS WITH OXYGEN. R. G. Freemantle (Univ. of Birmingham, England), W. M. Gibson and D. J. Prowse (Univ. of Bristol, England), and J. Rotblat (Univ. of London, England). *Phys. Rev.* **92**, 1268-9 (1953). Dec. 1.

The charged particles emitted when O is bombarded with 19-Mev deuterons have been studied by a photographic-plate method. The angular distributions of the two groups of protons from the reaction $O^{16}(d,p)O^{17}$, O^{17} being formed in the ground and 0.88-Mev states, have been found to be in qualitative agreement with the predictions of the stripping theory. Similar measurements have been made for the elastically scattered deuterons and for the α particles from the reaction $O^{16}(d,\alpha)N^{14}$; the curve for the latter shows peaks at about 40, 90, and 140° and is nearly symmetrical about 90°. (auth)

1433

SCATTERING OF 9.5-MEV PROTONS BY CARBON AND OXYGEN. W. E. Burcham (Univ. of Birmingham, England), W. M. Gibson and A. Hossain (Univ. of Bristol, England), and J. Rotblat (Univ. of London, England). *Phys. Rev.* **92**, 1266-7(1953). Dec. 1.

The elastic and inelastic scattering of 9.5-Mev protons by C^{12} and O^{16} nuclei have been studied by means of photographic plates. The 4.43-Mev state of C^{12} , as well as the 6.05-, 6.13-, 6.9-, and 7.1-Mev states of O^{16} , have been observed. The angular distribution of the protons elastically scattered by C^{12} and O^{16} has been determined and compared with Rutherford scattering. In the case of the protons inelastically scattered by C^{12} , the angular distribution shows symmetry around 90°. (auth)

1434

THE SLOW NEUTRON CROSS SECTION OF WATER. Milton Danzker. (Westinghouse Electric Corp., Pittsburgh). *J. Chem. Phys.* **21**, 2089-90(1953). Nov.

A calculation of the total cross section of neutrons for H in water vapor has been made as a function of incident neutron energy in the thermal range. The calculation was made with the semi-classical MTV theory. There is a significant difference between the calculated curve and the experimental values obtained by Melkonian (*Phys. Rev.* **84**, 204(1951)) for liquid water. It is pointed out that there is considerable frequency shift and intensity variation between the infrared spectra of water vapor and liquid which would lead to an expected variation of neutron cross section between the two phases. (K.S.)

1435

GAMMA RADIATION FROM THE REACTION $C^{13}(p,\gamma)N^{14}$. H. H. Woodbury, R. B. Day, and A. V. Tollestrup. (Calif. Inst. of Tech., Pasadena). *Phys. Rev.* **92**, 1199-1206(1953) Dec. 1.

The capture radiation from $C^{13}(p,\gamma)N^{14}$ has been investigated and found to show cascade transitions which involve bound levels in N^{14} at 2.31, 3.95, 5.09, 5.81, 6.26, and 6.44 Mev, in addition to the resonance levels at 8.06, 8.62, 8.70, 8.90, 8.98, 9.17, and 9.49 Mev. (auth)

1436

TWO-BODY SCATTERING AT LOW ENERGY. Benjamin Roth. (Univ. of Conn., Storrs). *Phys. Rev.* **92**, 1250-2 (1953) Dec. 1.

A series expansion in k is derived for the scattered wave $f(\theta)$ in a short-range field. All angular momentum waves are treated. The "shape-independent approximation" formula is derived from this series, and limits on its validity are given. It is shown that for large scattering lengths the series for $k \cot \delta$ must be used; for small scattering lengths the series for f must be used. (auth)

RADIATION EFFECTS

1437

THE COLOURING OF DIAMONDS BY NEUTRON AND ELECTRON BOMBARDMENT. R. A. Dugdale (Atomic Energy Research Establishment, Harwell, Berks, England). *Brit. J. Appl. Phys.* **4**, 334-7(1953) Nov.

The coloring of diamonds by neutron and electron bombardment and some effects of subsequent heating are described. The coloring is associated with the introduction of Frenkel defects by bombardment. Evidence for the natural occurrence of radiation-colored diamonds is presented. (auth)

RADIOACTIVITY

1438

BETA-GAMMA POLARIZATION CORRELATIONS. Donald R. Hamilton (Princeton Univ. and Inst. for Advanced Study, Princeton, N. J.) and Aaron Lemonick and Francis M. Pipkin (Princeton Univ., Princeton, N. J.). *Phys. Rev.* **92**, 1191-8(1953). Dec. 1.

The polarization of the γ ray emitted at an angle of 90° to the preceding β particle has been measured for certain β - γ cascades in K^{42} , As^{76} , Rb^{86} , Sb^{124} , and Cs^{134} , as selected by β absorbers when necessary. The polarimeter was checked by observing the polarization of the γ rays of Cs^{137} and Co^{60} when Compton-scattered through 90°. Of the γ 's investigated, those of K^{42} and Cs^{134} have no observable polarization. For the other three elements, the sign of the polarization correlation, taken in combination with the sign of the angular correlation reported by other observers, uniquely determines that no parity change occurs in the γ emission, corresponding to electric quadrupole radiation in decay of the excited state. (auth)

1439

NOTE ON THE BETA INTERACTION. R. Finkelstein and P. Kaus (Univ. of Calif., Los Angeles). *Phys. Rev.* **92**, 1316-19(1953). Dec. 1.

It is shown that the most general Lorentz invariant interaction between four mutually anticommuting fields leads to matrix elements of the form

$$(S - T + P)f_1(n, m) + (V - A)f_2(n, m) + (S - A - P)f_3(n, m).$$

In the charge-exchange order, neutron and muon decay are compatible with $f_2 = f_3 = 0$; charged pion decay appears to correspond to $f_1 = f_3 = 0$. It is noted that the hypothesis of the same interaction between all fermions does not imply that f_1 , f_2 , and f_3 are numerical constants; it is possible that they are functions of new variables (n, m) needed to characterize the associated Feynman diagrams: n indicates the number of particles produced in the reaction and m the number of particles minus antiparticles. A simple choice of the f_i can be made in such a way that the interaction is sometimes $S - T + P$, sometimes $V - A$, and never $S - A - P$. (auth)

1440

THE ISOMERIC TRANSITION OF Pb^{207} AS AN ENERGY STANDARD IN BETA SPECTROSCOPY. David E. Alburger. (Nobel Inst. of Physics, Stockholm, Sweden). *Phys. Rev.* **92**, 1257-9(1953) Dec. 1.

The K-conversion line of the 1.06-Mev isomeric transition following the electron-capture decay of Bi^{207} is suggested as a useful energy standard for β spectroscopy. While the 50-yr half life and 10% conversion coefficient are comparable to Cs^{137} , the 60% higher energy, larger percentage K to L momentum separation, and the possibility of making thin and more uniform sources may be advantageous. Precision measurements have been carried out in a double-focusing spectrometer by comparison with the 1.02-Mev electrons of Bi^{214} . The Pb^{207} K line has a momentum of

4657.9 ± 1.0 gauss-cm, from which an electron energy of 975.9 ± 0.3 kev and a transition energy of 1063.9 ± 0.3 kev are derived. Measurements have also been made on the K/L and K/(L+M) ratios, which are 3.95 ± 0.25 and 3.00 ± 0.25 , respectively. When compared with data on other M4 transitions, these results indicate that deviations from the empirical K/L curves take place at high Z. The usefulness of Bi^{207} as a test source for β - γ coincidence detectors is discussed. (auth)

1441

ERBIUM¹⁶⁵ AND THULIUM¹⁶⁵. Thomas H. Handley and Elmer L. Olson. (Oak Ridge National Lab., Tenn.). *Phys. Rev.* 92, 1260-1 (1953) Dec. 1.

A 75-min activity produced by bombarding Ho^{165} with protons is assigned to Er^{165} . A 24.5-hr activity produced by proton bombardment of Er is assigned to Tm^{165} . Gamma-ray spectra are given for both isotopes. (auth)

1442

LIFETIME MEASUREMENTS FOR THE FIRST EXCITED STATES OF O^{17} AND B^{10} FROM RECOIL STUDIES. Jacques Thirion and Valentine L. Telegdi. (Calif. Inst. of Tech., Pasadena). *Phys. Rev.* 92, 1253-5 (1953) Dec. 1.

The following lifetimes have been measured: O^{17} 870-kev level, $(2.5 \pm 1) \times 10^{-10}$ sec; B^{10} 720-kev level, $(7 \pm 2) \times 10^{-10}$ sec. These values are compared with theoretical estimates based on the independent-particle model. Core excitation is required to explain the O^{17} lifetime. (auth)

1443

DECAY OF ^{165}Dy (1.2 min) AND ^{165}Dy (2.3 hr). W. C. Jordan, J. M. Cork, and S. B. Burson. (Argonne National Lab., Lemont, Ill. and Univ. of Michigan, Ann Arbor). *Phys. Rev.* 92, 1218-21 (1953) Dec. 1.

The activities induced by neutron capture in Dy^{164} have been studied with 180° photographic internal conversion electron spectrometers and a scintillation coincidence spectrometer. The metastable transition energy is 108.0 ± 0.2 kev. Other γ rays of approximately 160, 360, and 515 kev are associated with the 1.2-min activity and appear to follow β decay from the metastable level. Gamma rays of 94.4 ± 0.2 , 279.4 ± 0.8 , 361.2 ± 1.0 , 634 ± 3 , 710 ± 20 , and 1020 ± 30 kev follow the 2.3-hr β decay from the ground state. Coincidences are observed between members of the pairs (279)-(710) and (361)-(634). The 94-kev γ ray is coincident with a β transition of about 1.2 Mev, while the other γ radiations are coincident with a softer β component (~ 0.3 Mev). (auth)

1444

THE DIRECTIONAL CORRELATION OF THE Pb^{204} γ - γ CASCADE. H. Frauenfelder, J. S. Lawson, Jr., W. Jentschke, and G. DePasquali. (Univ. of Illinois, Urbana). *Phys. Rev.* 92, 1241-4 (1953) Dec. 1.

The directional correlation of the Pb^{204} γ - γ cascade has been measured in chemical compounds and in a liquid Pb-Tl alloy. The values for the anisotropy of the Pb^{204} cascade in the chemical compounds vary between 0.08 ± 0.04 and 0.46 ± 0.04 , thus showing a pronounced influence of extranuclear fields. The anisotropy in the liquid Pb-Tl alloy, 0.49 ± 0.05 , excludes the assignment 7^- for the second excited state of Pb^{204} . The only decay scheme compatible with all experimental data requires the assignments 2^+ and 6^+ to the first and second state, respectively. The first γ transition in Pb^{204} must be a mixture of approximately 90% E4 and 10% M5. (auth)

1445

A SYSTEM OF α ENERGY. S. Sengupta (Krishnagar Coll., India). *Z. Physik* 134, 413-18 (1953). (In German)

The graph of the α energy of nuclei with an even neutron number as a function of the atomic number reveals a re-

markable regularity. For a constant neutron number, E_α increases almost linearly with Z, with the exception of certain proton numbers for which irregularity appears. From an investigation of this irregularity the existence of a more or less stable proton shell appears probable. It is shown that the general behavior of the α energy as a function of N and Z can be explained by a neutralization of the nuclear force. (tr-auth)

1446

MEASURE OF THE β ACTIVITY FROM THICK SOURCES. Pierre Lerch (Univ. de Lausanne, France). *Helv. Phys. Acta* 26, 663-90 (1953) Nov. 16. (In French)

The autoabsorption of β radiation from P^{32} was studied to obtain a measure of the relative or absolute activity from thick sources. The variations of autoabsorption are given as a function of the geometric factor, of the retrodiffusion factor, of the ratio of the area of the window of the detector to that of the source, of the presence of screens between the source and the detector, of the compactness of the source, and of the chemical nature of the radioactive substance. The conditions are indicated which the geometric and retrodiffusion factors ought to satisfy in order that the curve of autoabsorption be an exponential (for the mass lower than that for which the saturation of autoabsorption is reached). The activity of a thick source thus measured can be corrected for the autoabsorption of the β radiation and compared to that of a thin source. The absolute β activity of thick sources can be determined like that of thin sources, with an error of the order of 5 to 8%. (tr-auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

1447

CRYSTAL HYPERFINE STRUCTURE IN THE SPECTRUM OF PRASEODYMIUM SALTS. A. M. Hellwege and K. H. Hellwege (Physikalisches Institut, Göttingen, Germany). *Z. Physik* 135, 615-19 (1953). (In German)

Several cases of crystal hyperfine structure are compared. The crystal hyperfine structure depends on the crystal quantum number of the electron term and is strongly dependent on the preparation, especially on contamination with other rare earths. It is reduced by the interaction of other Pr salts. (J.S.R.)

1448

ZEEMAN EFFECT ON THE ELECTRON AND VIBRATION LINES IN SINGLE CRYSTALS OF PRASEODYMIUM AND NEODYMIUM SALTS. J. Brochard (Institut des Basses Températures et du Grand Electroaimant, Bellevue, France) and K. H. Hellwege (Physikalisches Institut der Universität, Göttingen, Germany). *Z. Physik* 135, 620-38 (1953). (In German)

The Zeeman effect on the electron and vibration lines in single crystals of Pr and Nd salts was studied by photographing the spectra in a field of 42,000 gauss. The temperature shift was determined at 4.2, 14.0, 20.4, and 58°K. The results are tabulated. The theory of the Zeeman effect is discussed. (J.S.R.)

1449

THE FERROMAGNETISM OF DYSPROSIUM. Félix Trombe. *Bull. soc. chim. France* 10, 1013 (1953) Nov. (In French)

Dysprosium at high temperatures is paramagnetic and follows the Curie-Weiss law. Between 250 and 178°K it is paramagnetic but does not follow this law. Down to 150°K Dy has an antiferromagnetic zone which is characterized by an augmentation of χ as a function of the field applied. With a zero field the Curie point is approximately 85°K. (J.S.R.)

1450

OBSERVATIONS ON THE VAPOR PRESSURES OF THE RARE EARTH METALS, THEIR SEPARATION AND PURI-

FICATION. Félix Trombe. Bull. soc. chim. France **10**, 1010-12(1953) Oct. (In French)

The rare earth elements in the metallic state have very different vaporization temperatures; in particular, the elements Sm, Eu, and Yb have at the same time the normal trivalence of the rare earths and the divalence appearing in the vapor considerably below the melting point. The favored dissociation of certain compounds of these elements is characteristically divalent. These properties were used to separate some rare earths and to purify, by distillation, the metals of this group. (tr-auth)

1451

UTILIZATION OF NITRILOTRIACETIC ACID FOR THE SEPARATION OF THE CERIC EARTHS BY ION EXCHANGE. Jean Loriers and Denyse Carminati. Compt. rend. **237**, 1328-30(1953) Nov. 23. (In French)

The separation of the rare earths by ion exchange with nitrilotriacetic acid as the eluant was attempted. In separations made at pH 4, the greater part of Nd and Pr and all the La were obtained in a pure form. The best results for the ceric earths seem to be obtained at a pH from 4 to 6. The elution of the rare earth begins immediately after the passage of nitrilotriacetic acid, and more concentrated solutions are obtained with it than with citric acid. (J.S.R.)

SHIELDING

1452

Oak Ridge National Lab.

INTRODUCTION TO NUCLEAR SHIELDING FOR ENGINEERS. H. M. Glen. [Oct. 1951] 30p. Contract W-7405-eng-26. (CF-51-10-221)

The basic aspects of nuclear shielding are presented for the benefit of engineers who may be confronted with the problems of handling, using, or storing radioisotopes for tracer work in industry or agriculture. The common radiations and units of quantity and intensity are defined and discussed. Two specific shielding problems involving 100-c Co⁶⁰ and 350-mc Na²⁴ sources are solved. A table of nuclear data (half life and β and γ emission) of ~90 radioisotopes is included. Graphs are included for a number of common shielding materials showing the inches to reduce the γ intensity by a factor of 10 as a function of the energy in Mev. (L.M.T.)

SPECTROSCOPY

1453

VIBRATIONAL SPECTRA OF FORMIC ACID (MONOMER) AND ITS DEUTEROSUBSTITUTED FORMS: COMPUTATION AND INTERPRETATION. L. M. Sverdlov. Translated from Doklady Akad. Nauk S.S.S.R. **91**, 503-5(1953). 4p. (NSF-tr-110)

An interpretation of the formic acid spectra on the basis of analysis of available experimental data and calculations of the frequencies and force constants of the formic acid molecule are presented. The secular equations of HCOOH, HCOOD, DCOOH, and DCOOD molecules are solved, from which the molecular frequencies and spectra are derived and compared with observed values. Results of the computation of the frequencies prove that the system of the computed dynamic coefficients reflects adequately the real potential field of the formic acid molecule. (J.A.G.)

1454

PHOTOELECTRIC METHOD OF RECORDING THE CHANGE IN TIME OF THE SPECTRA OF LIGHT FLASHES. M. P. Vanyukov and L. D. Khazov. Translated from Doklady Akad. Nauk S.S.S.R. **92**, 523-4(1953). 2p. (NSF-tr-158)

A photoelectric method is presented for registering the change in time of the spectra of light flashes, which en-

ables the curve of spectral distribution of radiation to be obtained directly at any given instant of time, the resolving power in time being limited only by possibilities of recording the rapidly occurring phenomena on an oscillograph, i.e., at present $\sim 10^{-8}$ sec. (J.A.G.)

1455

BROADENING OF SPECTRUM LINES BY QUADRUPOLE STARK EFFECT. I. I. Sobelman and L. A. Vainshtein. Translated from Doklady Akad. Nauk S.S.S.R. **90**, 757-60 (1953). 5p. (NSF-tr-161)

Equations are developed for calculating the quadrupole broadening of energy levels due to the presence of non-homogeneous electric fields. Specific examples are made of the atom with one valence electron and several non-equivalent valence electrons, such as Na, Ca, and Ca⁺. It is pointed out that quadrupole effects in ions become important in cases of collisions with neutral H, where an ion induces a dipole moment which in turn produces a field resulting in quadrupole splitting. (K.S.)

THEORETICAL PHYSICS

1456

ON THE MANY-BODY PROBLEM IN QUANTUM MECHANICS. A. F. Tsander. Translated from Doklady Akad. Nauk S.S.S.R. **90**, 761-6(1953). 4p. (NSF-tr-154)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 7-5453.

1457

ON THE THEORY OF STRONG COUPLING IN MESON FIELDS. B. T. Geilikman. Translated from Doklady Akad. Nauk S.S.S.R. **90**, 991-4(1953). 4p. (NSF-tr-162)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 7-5661.

1458

AN AUGMENTED PLANE-WAVE METHOD FOR THE PERIODIC POTENTIAL PROBLEM. II. M. M. Saffren and J. C. Slater. (Mass. Inst. of Tech., Cambridge). Phys. Rev. **92**, 1126-8(1953). Dec. 1. (cf. NSA 8-960.)

It is shown that the augmented plane-wave method recently proposed can be given an alternative interpretation which leads to a much simpler analytical formulation. A plane wave of energy E_0 outside the spherical atoms is joined continuously, but with a derivative which is discontinuous, to spherical solutions of Schrödinger's equation inside the spherical atoms, corresponding to an energy E , to be determined. The expectation value of the energy for this combined wave function is computed, consisting of contributions from the plane-wave region, the spherical atoms, and also a surface contribution from the surface of the sphere, since the discontinuous derivative is equivalent to an infinite Laplacian which integrates to a finite contribution over the sphere. E is regarded as a parameter, and it is varied to make the expectation value of energy stationary. The resulting wave function is proved to be identical with that set up in Part (I). Furthermore, the energy E inside the spheres proves to be identical with the expectation value of the energy, so that the functions are exact solutions of Schrödinger's equation inside but not outside the sphere, since the energy of the plane wave E_0 is different from E . However, this discrepancy is just canceled in the expectation value of energy by the surface integral. The resulting formulas for energy and wave function are much more convenient to use than those in Part (I). (auth)

1459

THE BINARY REARRANGEMENT COLLISION. Saul Altschuler. (Iowa State Coll., Ames). Phys. Rev. **92**, 1157-9(1953). Dec. 1.

The theory of the general binary collision is discussed, and it is demonstrated that the rearrangement scattered

amplitude can be derived from the integral equation which is convenient for determining the direct (no rearrangement of particles) scattered amplitudes. As a consequence, it is shown that no ambiguity in matrix element for the rearrangement amplitude in Born approximation exists. (auth)

1460

NUCLEAR REACTIONS BETWEEN CHARGED PARTICLES. Marcos Moshinsky (Univ. de México, Mexico). *Rev. mexicana fis.* 2, 244-67(1953) Oct. (In Spanish)

In the present paper the formalism for the description of resonance reactions in Fock space, which the author developed previously for particles without coulomb interaction, (NSA 5-2969) is generalized for charged particles. In particular it is shown that the distribution of poles of the S-matrix for the reaction is not affected by the presence of the long range electrostatic interaction. For low energies the phase shifts can be expressed in terms of the scattering length and effective range, as in the analysis of Bethe and Teichmann. The effect of the coulomb barrier on the width of the resonance levels is also discussed. (auth)

1461

THE THEORY OF QUANTIZED FIELDS. IV. Julian Schwinger (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 92, 1283-99(1953). Dec. 1. (cf. NSA 7-3640, 7-3968, and 7-3969).

The principal development in this paper is the extension of the eigenvalue-eigenvector concept to complete sets of anticommuting operators. With the aid of this formalism a transformation function is constructed for the Dirac field, as perturbed by an external source. This transformation function is enlarged to describe phase transformations and, when applied to the isolated Dirac field, yields the charge and energy-momentum eigenvalues and eigenfunctions. The transformation function describing the system in the presence of the source is then used as a generating function to construct the matrices of all ordered products of the field operators for the isolated Dirac field. The matrices in the occupation number representation are exhibited with a classification that effectively employs a time-reversed description for negative frequency modes. The last section supplements III by constructing the matrices of all ordered products of the potential vector for the isolated electromagnetic field. (auth)

1462

RELATIVISTIC PARTICLE DYNAMICS. II. B. Bakamjian and L. H. Thomas (Columbia Univ., New York). *Phys. Rev.* 92, 1300-10(1953). Dec. 1. (cf. *Phys. Rev.* 85, 868-72 (1952); NSA 6-2796).

The relativistic dynamics for a system of noninteracting particles in Hamiltonian form is separated by a contact transformation into motion of their center of mass and internal motion. Interaction at a distance between them is then introduced into the expression for the rest mass in terms of the internal variables. This gives a dynamics for which invariance over space displacements and rotations is trivial, and which is rigorously invariant over Lorentz transformations. Earlier approximate treatments may be reduced by contact transformations to special cases of the general treatment. (auth)

1463

REDUCTION OF RELATIVISTIC TWO-PARTICLE WAVE EQUATIONS TO APPROXIMATE FORMS. II. Zeno V. Chraplyvy (Saint Louis Univ., Mo.). *Phys. Rev.* 92, 1310-15 (1953). Dec. 1.

The method of reduction of two-particle relativistic wave equations (an extension of the Foldy-Wouthuysen method), as given in Part I, (*Phys. Rev.* 91, 388(1953)) was applicable only if $m_I \approx m_{II}$. Other variants of the procedure, free from this restriction, are developed now. On the basis of a dis-

cussion of properties of the matrices involved, it is found that the postulate of an "even-even" transformed Hamiltonian was too far-reaching. The less stringent requirement of a "uU separating" or an "lL separating" \mathcal{H}_{tr} leads to a whole class of usable transformations, which includes the transformation of Part I as a special case. Another important special case, (that of the "least change" transformation) has been calculated through in detail. Different transformations give different expressions for \mathcal{H}_{tr} , but they coincide after (as a part of the next step of the procedure) the matrices β^I and β^{II} are replaced by 1 (or -1). Consequently, the reduced wave equation is the same in all cases. (auth)

1464

SEMICLASSICAL METHODS IN MESON PROCESSES. Joseph A. Thie (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 92, 1282-3(1953). Dec. 1.

Simple calculations analogous to the electrodynamical Weizsäcker-Williams method have been carried out for pseudoscalar coupling. By integrating a fast nucleon's virtual-meson spectrum with the appropriate meson scattering cross section, a nucleon-nucleon cross section is obtained. Results are given for neutron-proton bremsstrahlung and nucleon-nucleon meson production. When comparison is possible, results obtained by this method agree approximately with more exact calculations. (auth)

1465

RETARDATION OF MESON FIELDS. Haakon Olsen, P. Werenskiöld, and H. Wergeland. *Kgl. Norske Vidensk. Selskabs, Forh.* 25, 54-9(1952).

A theoretical treatment of the retardation of meson fields is developed for the scalar case of a potential field around a moving point charge. (K.S.)

1466

A DESCRIPTION OF THE BOUND STATE IN THE FIELD THEORY. Wladimir Glaser and Wolfhart Zimmermann (Max Planck-Institut für Physik, Göttingen, Germany). *Z. Physik* 134, 346-62(1953). (In German)

By means of the example of an independent electron in a given external field, a homogeneous integral equation is derived through comparison of the spatial configuration method and field quantization. The equation describes the bound state in the reciprocal actions of the field theory. A single general consequence for the field theory, which the existence of a bound state introduces, was investigated. (tr-auth)

1467

THE RELATION BETWEEN THE THEORY OF NUCLEAR FISSION AND THE THEORY OF NUCLEAR QUADRUPOLE MOMENT. Dieter Pfirsich (Institut für Theoretische Physik, Frankfurt a. M., Germany). *Z. Physik* 135, 593-601(1953). (In German)

At the mass at which a nucleus approaches the drop model, its deformability increases. The approach to the drop model can be reached by excitation of the nucleus. In the nonexcited state—important in the case of nuclear quadrupole moment—the deformability of the nucleus is chiefly intelligible on the basis of the Uncertainty Principle. In the excited state—important in the case of nuclear fission—the deformability is interpreted by surface tension and Coulomb force. The discrepancy between the theory of nuclear fission and the theory of nuclear quadrupole moment arises from the essentially different deformabilities of the nuclei which must be used in each theory. (tr-auth)

1468

DERIVATION OF THE QUANTUM THEORY FROM A CLASSICAL, CAUSAL DETERMINANT MODEL. W. Weizel (Inst. für Theoretische Physik, Bonn, Germany). *Z. Physik* 134, 264-85(1953). (In German)

The conception that the quantum theory does not permit a

causal-determinant interpretation of atomic reactions on a single object is not provable. It can be refuted because the formalisms of the quantum theory are derived from a classical determinant model. The Fenyess and Bohm interpretations of the quantum theory indicate no such model and do not refute the conception. It is shown that, with the aid of a hypothetical unknown particle, called the "zenon", a determinant model can be constructed from which the quantum theory is derived. With that, the thesis that a causal interpretation of the quantum theory is impossible is refuted. The alternate possibility of the existence of an unknown particle is encountered. (tr-auth)

URANIUM AND URANIUM COMPOUNDS

1469

Joint Establishment for Nuclear Energy Research (Norway) U^{235} FISSION CROSS SECTION. Dragoslav Popovic and Bertel Grimeland. 1953. 7p. (JENER-19)

The fission cross section of U^{235} was measured in the thermal column of JEEP using nuclear photographic emulsion for registering fission. The quantity of U in the sample was determined by measuring the α activity of U also by means of nuclear photographic emulsion. The neutron flux was determined by irradiating NaI crystals for which the absolute activity of Na had been determined by a modified counting method. As Na is supposed to be a 1/v absorber, the measurement was performed using the whole thermal neutron spectrum on the assumption that the 1/v law for fission holds good in the thermal region. Since Na is used for determining the neutron flux, or rather the neutron density, the fission cross section was compared with the activation cross section of Na. (auth)

PATENTS

CHEMISTRY

1470

PROCESS FOR SEPARATION AND PURIFICATION OF ALKYL PHOSPHORIC ACIDS. H. W. Crandall and D. C. Stewart (to U. S. Atomic Energy Commission). U. S. Patent 2,658,909, Nov. 10, 1953.

A method is described for separating the mono- and dialkyl esters of phosphoric acid by equilibrating a mixture thereof with a first phase exhibiting aqueous characteristics and a second phase from the group consisting of amyl alcohol, dibutyl carbitol, diisopropyl ether, dibutyl ether, methyl isobutyl ketone, and diethyl ether. The phases are separated and washed with the solvent of the other phase to remove minor amounts of the secondary component, thereby purifying the primary constituent extracted.

1471

PROCESS FOR COPOLYMERIZATION OF $CF_2 = CF_2$ WITH $CF_2 = CFCl$. W. T. Miller (to U. S. Atomic Energy Commission). U. S. Patent 2,662,072, Dec. 8, 1953.

The method for producing thermoplastic halocarbon polymers comprises copolymerizing tetrafluoroethylene and trifluoromono-chloroethylene in the presence of trichloroacetyl peroxide as a polymerization promoter at a temperature in the range of -20 to $0^\circ C$ to produce a plastic copolymer composed of about 25 to about 85 wt. % of tetrafluoroethylene and composed for the balance almost entirely of trifluoromono-chloroethylene.

1472

PYROLYSIS OF TRIFLUOROCHLOROETHYLENE POLYMERS. W. T. Miller (to U. S. Atomic Energy Commission). U. S. Patent 2,664,449, Dec. 29, 1953.

A process is described for preparing perhalocarbons of low and intermediate molecular weight by thermal degradation of high molecular weight solid polymers. A solid polymer of monochlorotrifluoroethylene having a melting point of less than $200^\circ C$ is heated in a reaction zone at a temperature of from about 300 to $450^\circ C$ to cause pyrolysis, resulting in a major portion of materials of substantially higher molecular weight than the monomer. The pyrolysis products are distilled from the reaction zone as formed.

1473

HEAT TREATMENT OF POLYTRIFLUOROCHLOROETHYLENE. W. T. Miller (to U. S. Atomic Energy Commission). U. S. Patent 2,667,474, Jan. 26, 1954.

The process for producing a tough, thermoplastic orientable polytrifluoro-chloroethylene comprises heating the polymer to above its transition temperature, rapidly quenching the hot polymer, and heating the quenched polymer for a relatively long time to a temperature of at least $150^\circ C$ but below its transition temperature.

ENGINEERING

1474

ELECTROMAGNETIC PUMP. K. O. Donelian (to U. S. Atomic Energy Commission). U. S. Patent 2,658,452, Nov. 10, 1953.

The improved electromagnetic pump for pumping electrically conducting liquids comprises a structure wherein the electrically conducting liquid is whirled in the pump chamber by the action of a rotating magnetic field and is forced out by centrifugal force through an aperture in the periphery of the chamber.

MINERALOGY, METALLURGY, AND CERAMICS

1475

WELDING BERYLLIUM AND BERYLLIUM ALLOYS. D. C. Martin (to U. S. Atomic Energy Commission). U. S. Patent 2,658,981, Nov. 10, 1953.

This process of welding Be-base metals comprises welding the metals using a shield gas consisting of from 95 to 99.5% by volume of a noble gas and from 5 to 0.5% by volume of a fluorochlorohydrocarbon selected from the group consisting of fluorochloromethanes and fluorochloroethanes.

PHYSICS

1476

METHOD AND APPARATUS FOR FOCUSING CHARGED PARTICLES. J. G. Backus and B. Peters (to U. S. Atomic Energy Commission). U. S. Patent 2,658,150, Nov. 3, 1953.

A method for the focusing of divergent beams of charged particles and more particularly an improved method and apparatus for electrostatically increasing the sharpness of foci of divergent ion beams in the electromagnetic separation of ions are proposed.

1477

BEVATRON ACCELERATION REGULATION. G. M. Farly (to U. S. Atomic Energy Commission). U. S. Patent 2,658,999, Nov. 10, 1953.

A means for controlling the accelerating voltage in a particle accelerator of the bevatron type is described. The result is accomplished through the employment of an improved method and means of frequency modulating the accelerating voltage and means for initiating and terminating it in a particle accelerator.

1478

X-RAY DENSITOMETER. R. Bromberg and W. L. Martin (to U. S. Atomic Energy Commission). U. S. Patent 2,659,012, Nov. 10, 1953.

The improved method and means for density measurement has no effect on or physical contact with the material under test. The comparative adsorption of particles or

waves passed through a test sample and a standard sample is measured as an indication of the relative densities.

- 1479
BADGE METER. D. M. Davis and J. C. Hart (to U. S. Atomic Energy Commission). U. S. Patent 2,659,013, Nov. 10, 1953.

A combination badge and radiation meter to be worn by individuals who are subjected to ionizing radiations is described. The device is adapted to measure both the amount and intensity of the radiations to which the wearer is exposed.

- 1480
INTEGRATING ACCELEROMETER. C. N. Hickman (to U. S. Atomic Energy Commission). U. S. Patent 2,659,589, Nov. 17, 1953.

The integrating accelerometer is especially useful in recording the variations in velocity of any moving body. A gas, the rate of flow of which under a differential pressure is responsive to acceleration, is employed.

- 1481
MASS SPECTROMETER. G. H. Lee (to U. S. Atomic Energy Commission). U. S. Patent 2,659,822, Nov. 17, 1953.

Isotope separation equipment and more particularly a mass spectrometer employing alternating electrostatic fields for the separation of isotopes of elements are described. The instrument comprises an ion source, means for accelerating the ions into a transverse alternating electrostatic field for selectively deflecting ions of different masses, collectors for ions spaced from the field, and means for decelerating the ions leaving the field for accentuating their deflection while traveling through the space to the collectors.

- 1482
RADIATION MEASURING DEVICE. G. Failla and H. H. Rossi (to U. S. Atomic Energy Commission). U. S. Patent 2,659,826, Nov. 17, 1953.

A method and apparatus for measuring the absolute radioactivity of radioactive samples which emit charged particles are described. The method comprises collecting at least 99% of the particles emitted from a radioactive source in a given interval of time on two symmetrical conducting elements juxtaposed in insulated relation in an evacuated region, the confronting surfaces having substantially the same scattering and secondary electron-producing characteristics with respect to charged particle radiation, and measuring the rate at which a charge is developed on at least one of the elements.

- 1483
ION SELECTOR. A. O. C. Nier (to U. S. Atomic Energy Commission). U. S. Patent 2,660,677, Nov. 24, 1953.

The improvement to increase the accuracy of a mass spectrometer comprises means for producing a relatively weak magnetic field transverse to the direction of ion movement ahead of the collecting plate for rejecting stray electrons, the strength of the field being insufficient to appreciably deflect ions.

- 1484
PLATE DESIGN FOR PULSE COLUMNS. W. A. Burns and W. F. Johnson (to U. S. Atomic Energy Commission). U. S. Patent 2,662,001, Dec. 8, 1953.

Stationary plates are disposed horizontally one above the other within the column. The plates are perforated to permit alternate passage of the fluids in opposite directions. In order to facilitate coalescence of each fluid after mixing and prior to passing through the perforations, opposite sides of each plate are composed of different material. The material on the top side is wettable by a heavier fluid, and the material on the lower side is wettable by a lighter fluid.

- 1485
TRANSMISSION FLUORIMETER. M. Slavin, M. H. Fletcher, and I. May (to U. S. Atomic Energy Commission). U. S. Patent 2,663,801, Dec. 22, 1953.

The new and improved fluorimeter utilizes the direct transmission of ultraviolet light through a comparatively thin sample of material and measures the emitted fluorescent light at a relatively large solid angle along the extended axis of the impinging ultraviolet light.

- 1486
NEUTRON DETECTOR. P. E. Ohmart (to U. S. Atomic Energy Commission). U. S. Patent 2,663,802, Dec. 22, 1953.

The apparatus comprises an electret for exposure to incident neutrons, means electrically coupled to the electret for detecting the changes in volume charge induced by neutron bombardment, and means coupled to the detector for counting and indicating the time rate of occurrence of the charges, the rate being proportional to the rate of incidence of neutrons on the electret.

- 1487
MAGNETIC ELECTRON MULTIPLIER. L. G. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,664,515, Dec. 29, 1953.

The apparatus comprises a homogenous magnetic field, an electrically conductive plate located in the magnetic field and parallel to the lines of flux of the magnetic field, a plurality of secondary electron emission dynodes located in the magnetic field and disposed in echelon parallel relation with respect to the conductive plate, means for establishing a uniform electrostatic field between the plate and the dynodes, the electrostatic field being perpendicular to the magnetic field, means for causing the moving charged particles to be detected to impinge on the dynode most remote from the plate whereby secondary electrons are produced which are attracted and amplified by the remaining dynodes in successive steps, and means for collecting the amplified number of secondary electrons produced by the last dynode.

- 1488
CONTAINER FOR NEUTRON IRRADIATED MATERIAL. J. F. Gifford and N. B. Garden (to U. S. Atomic Energy Commission). U. S. Patent 2,664,998, Jan. 5, 1954.

Hermetically sealed containers or receptacles adapted for use in the neutron irradiation of materials and for the subsequent handling, storage, or treatment of such irradiated materials are described. One object of the invention is to produce a container assembly comprising a plurality of container elements each of which serves a complementary function contributing to the combined safe and expeditious handling of neutron-irradiated materials.

- 1489
ION ACCELERATING AND FOCUSING SYSTEM. H. P. Yockey (to U. S. Atomic Energy Commission). U. S. Patent 2,665,384, Jan. 5, 1954.

Ion accelerating and focusing systems and particularly a system of electrodes for accelerating and focusing ions in electromagnetically operated equipment for the separation of substances or isotopes of elements, such as in calutrons for separating ions on a production scale, are described.

- 1490
SPECTROMETER. L. B. Borst (to U. S. Atomic Energy Commission). U. S. Patent 2,666,147, Jan. 12, 1954.

Improvements in a spectrometer wherein a curved reflecting surface is utilized to focus the incident rays of radiant energy are described. An object of the invention is to produce a radiant energy focusing spectrometer wherein the curved reflecting surface and the intensity indicator may be rotated to obtain a wave length spectrum of radiant energy from a stationary divergent source while simultane-

ously maintaining the necessary conditions to insure proper focusing.

1491

RAPID OPERATION AIR LOCK FOR CLOSED VESSELS. R. T. Avery (to U. S. Atomic Energy Commission). U. S. Patent 2,666,539, Jan. 19, 1954.

The air lock provides access chambers to adjacent closed vessels, particularly for use with the vacuum vessels of mass spectrometers or the like. A chamber or air lock sealingly secured to the apertured wall of a vacuum chamber is provided, and a spring-pressed closure is included which is movable into sealing relation with the wall portion defining the aperture and having also a position of translation away from and to one side of the aperture whereby the use of a probe for carrying the radiation-emitting substance axially of the aperture into the interior of the evacuated vessel is facilitated.

1492

SURVEY INSTRUMENT. C. J. Borkowski (to U. S. Atomic Energy Commission). U. S. Patent 2,666,865, Jan. 19, 1954. (cf. NSA 6-3479.)

Radiation detection and survey equipment and particularly a pulse type of survey instrument for detecting the presence of α particles, β particles, γ rays, and slow and fast neutrons, facilitating rapid survey of surfaces, tools, containers, etc., are described.

1493

LIGHT VALVE. W. E. Buck (to U. S. Atomic Energy Commission). U. S. Patent 2,667,104, Jan. 26, 1954.

A piezoelectric crystal-operated oscillograph for visually indicating variable voltages without imposing a load on the voltage source is described. The invention operates on a principle that light interference is used to measure variations in an electric potential which is impressed across a piezoelectric crystal.

1494

LIQUID LEVEL CONTROL. M. S. Fred and E. G. Rauh (to U. S. Atomic Energy Commission). U. S. Patent 2,667,178, Jan. 26, 1954.

The device provides independent control of the upper and lower levels of a liquid in a container. The apparatus employs two measuring elements producing a change in electrical resistance in response to a change in the condition to be responded to and associated electronic circuitry controlled by any change sensed by the measuring elements.

1495

MASS SEPARATOR. J. G. Backus (to U. S. Atomic Energy Commission). U. S. Patent 2,667,582, Jan. 26, 1954.

The instrument magnetically and electrically influences a beam of ions in order to resolve the ions into separate, distinguishable groups of like mass-to-charge ratio and provides visual indications of the value of these ratios as well as the relative abundance of the groups.